THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXIV. No. 1644.] LONDON, NOVEMBER 13, 1894. [46TH YEAR. PRICE 6d.

GAS AND WATER PIPES

1¼ to 12 IN. BORE.

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SOUTH STOCKTON-ON-TEES.

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INCANDESCENT GAS-LIGHT SYSTEM.

Consumes 3¾ cubic feet per hour.

Gives a light of 70 to 80 candle power.

Brilliant Light.

Perfectly Steady and Noiseless.

Smokeless.

Reduced Heat.

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Special Lamps constructed for Outside Lighting and Street Lighting; and Large Clusters of Lights made for Lighting Halls and large Areas from one centre.

Can be attached to any Gas-Fittings.

THE TRIUMPH OF GAS OVER ELECTRIC LIGHT.

Taking Gas at 3s. per 1000 cubic feet and Electric Light at 8d. per Board of Trade unit, the "C" Burner will produce an equal amount of light at **One-eighth the cost of Electric Light.** This cannot be disproved.

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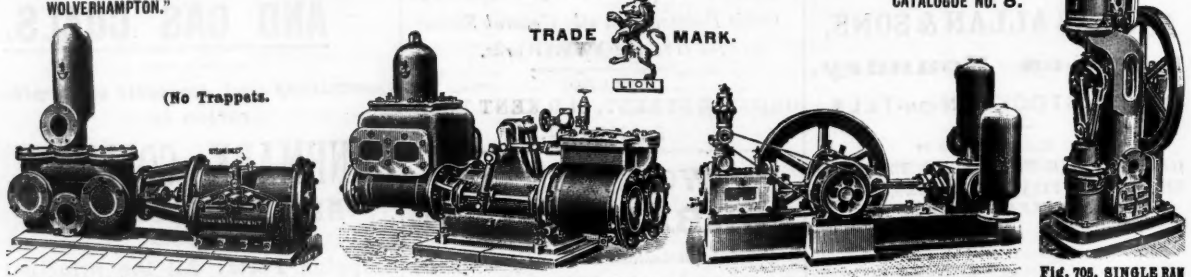

Fig. 600. "CORNISH" STEAM-PUMP FOR WATER.

Fig. 670. DUPLEX PUMP FOR GENERAL PURPOSES.

Fig. 685. "RELIABLE" PUMP FOR TAR AND THICK FLUIDS.

Fig. 705. SINGLE RAM PUMP FOR BOILER FEEDING, &c.

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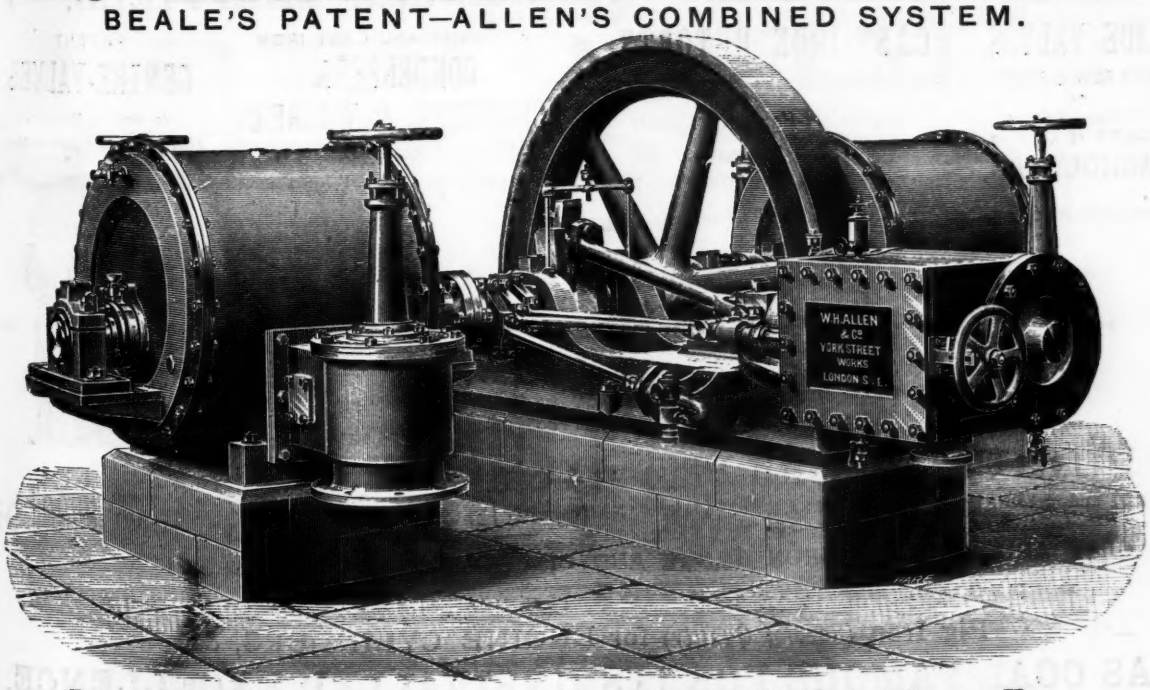

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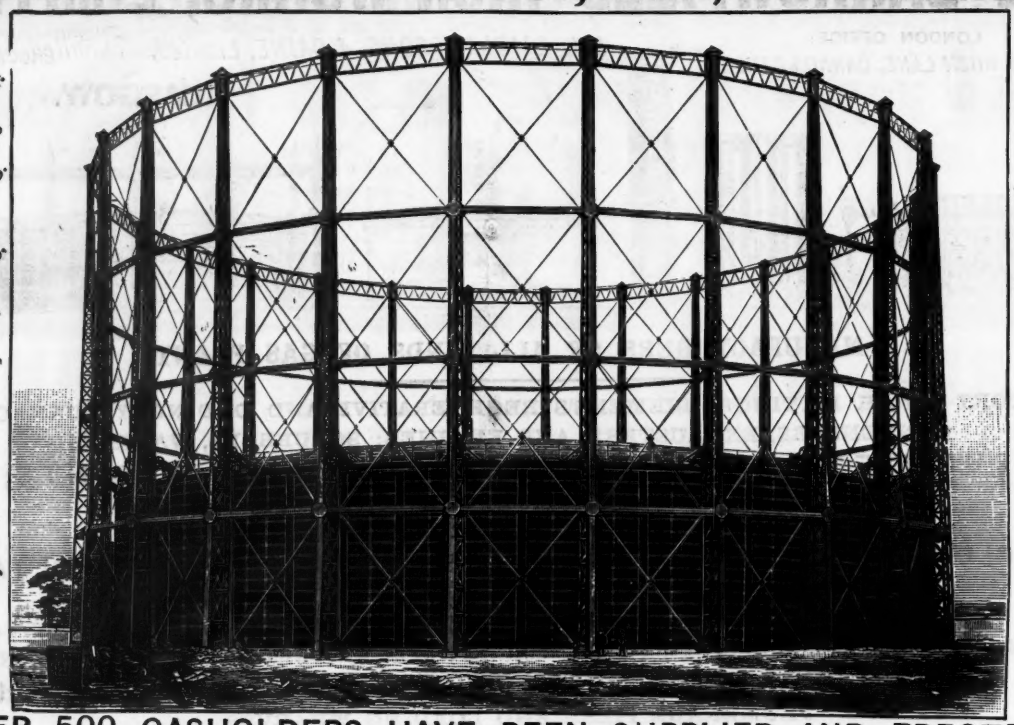

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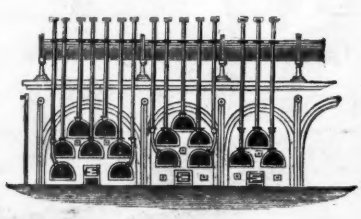

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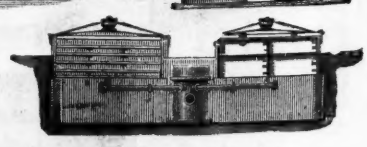

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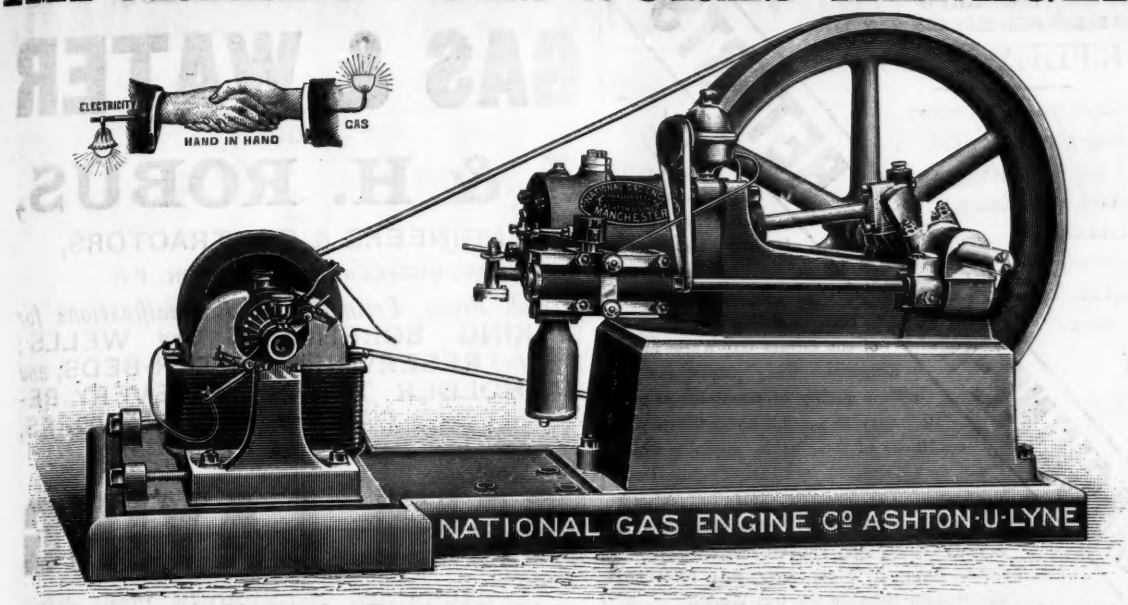

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Full Particulars sent upon Application.

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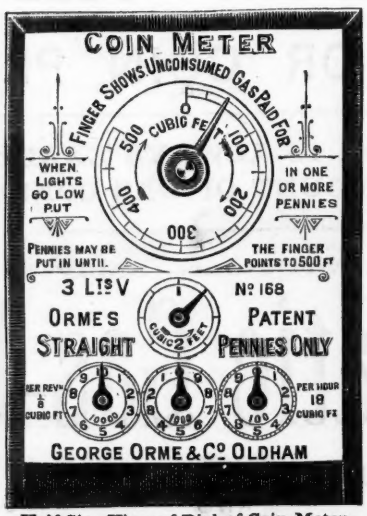
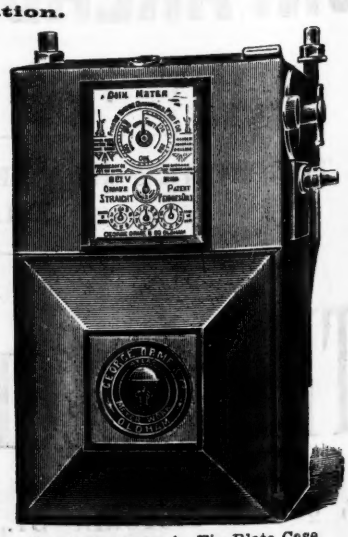


Half-Size View of Dial of Coin Meter.



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Is an unequalled combination of SIMPLICITY, CHEAPNESS, and EFFICIENCY.

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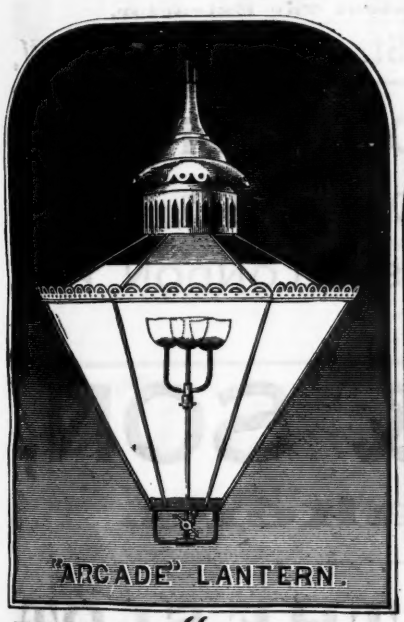

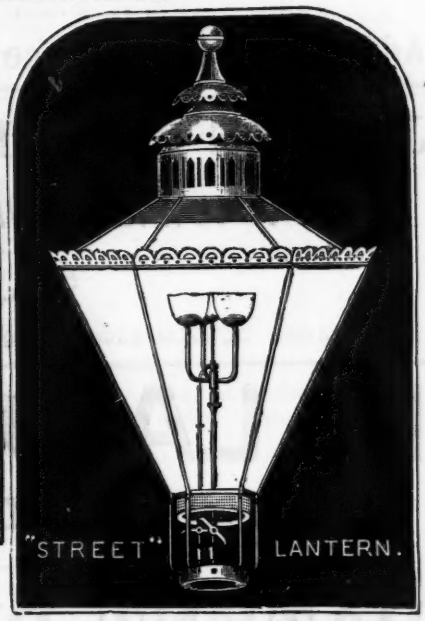

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Are the best in the Market for general use, and are very moderate in price.

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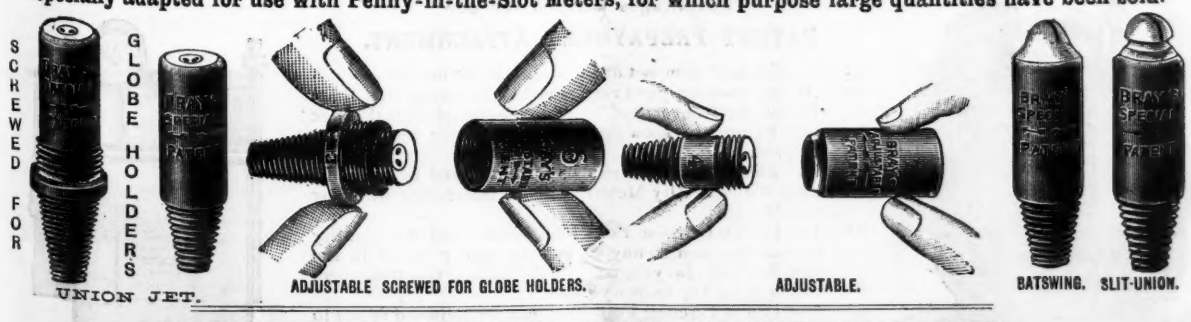
Gas Managers should try them on Consumers' Fittings; and they would see at once how to compete more effectively with the Electric Light.

Specially adapted for use with Penny-in-the-Slot Meters, for which purpose large quantities have been sold.



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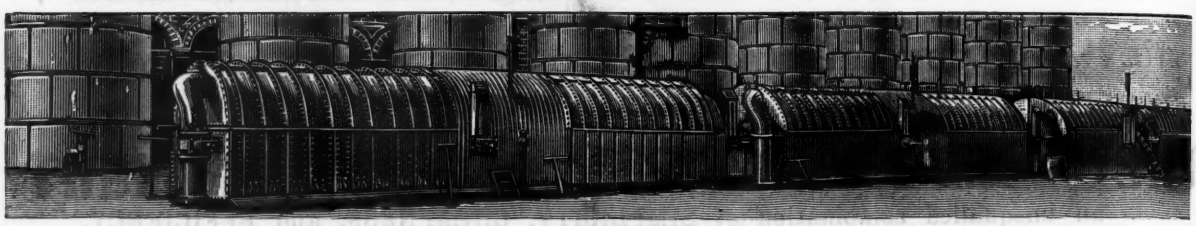
PATENT "STANDARD" WASHER-SCRUBBER

☞ **484** of these Machines (capable of dealing with **464,490,000** cubic feet of Gas daily) in use, which fact is given as evidence of this apparatus being the Most Efficient of any in the Market for the extraction of Ammonia, Carbonic Acid, and Sulphuretted Hydrogen from Coal Gas.



View of SIX PATENT "STANDARD" WASHER-SCRUBBERS, erected at the Beckton Station of The Gaslight and Coke Company (the Engines driving same being under Galvanized Iron Covers). This Company have 30 of these Machines in use. They are also in operation at a great number of Gas and other Works in this Country and Abroad.

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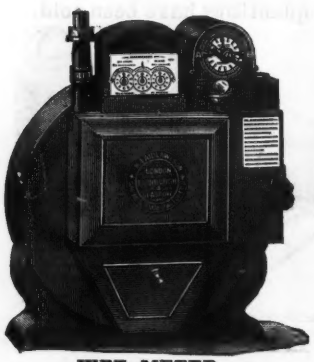
WET AND DRY

PREPAYMENT GAS-METERS.



WET METER.

Advantages claimed for our

PATENT PREPAYMENT ATTACHMENT.

1st—It is the most compact arrangement in the market.
2nd—All the working parts are mounted on a strong cast Brass Frame, the front end of which carries an additional Index and Pointer to show the number of cubic feet of Gas prepaid.
3rd—The whole attachment can be easily adapted to the ordinary Wet and Dry Meters, without interfering with any existing parts.
4th—The Patent Circular Feed Rack gives a POSITIVE quantity of Gas for each Penny, so that the money found in the cash-box will always agree with the value of Gas consumed, as shown by the ordinary index.
5th—The Patent Circular Feed Rack can be adjusted *in situ* to suit changes made in the price of Gas.

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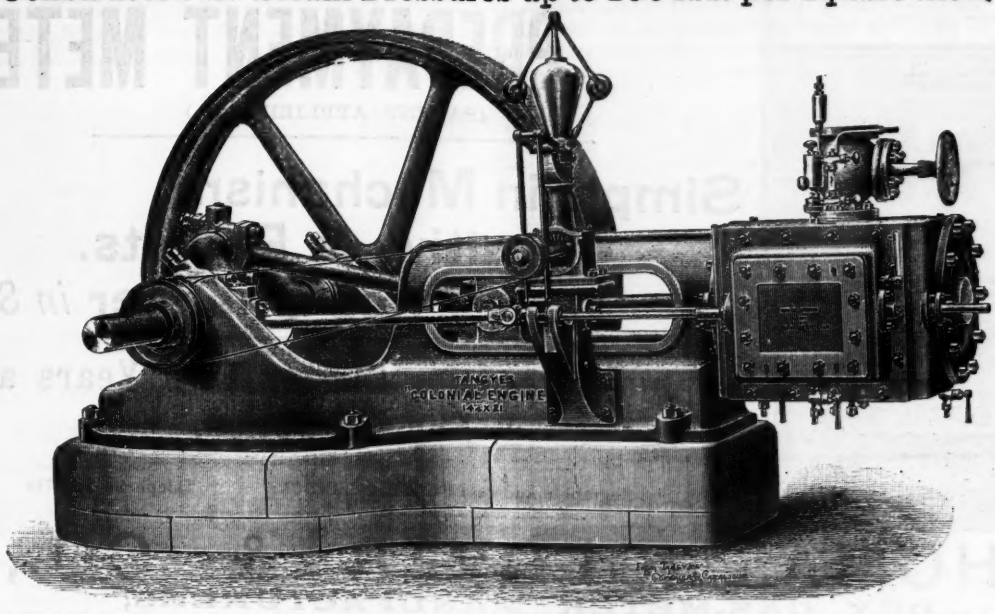
"COLONIAL" STEAM-ENGINE

Constructed for Steam Pressures up to 100 lbs. per square inch.



Tangyes' "Colonial" Steam-Engine, with the TANGYE-JOHNSON PATENT AUTOMATIC CUT-OFF GEAR. From a Photograph of the 14½ in. by 21 in. size.

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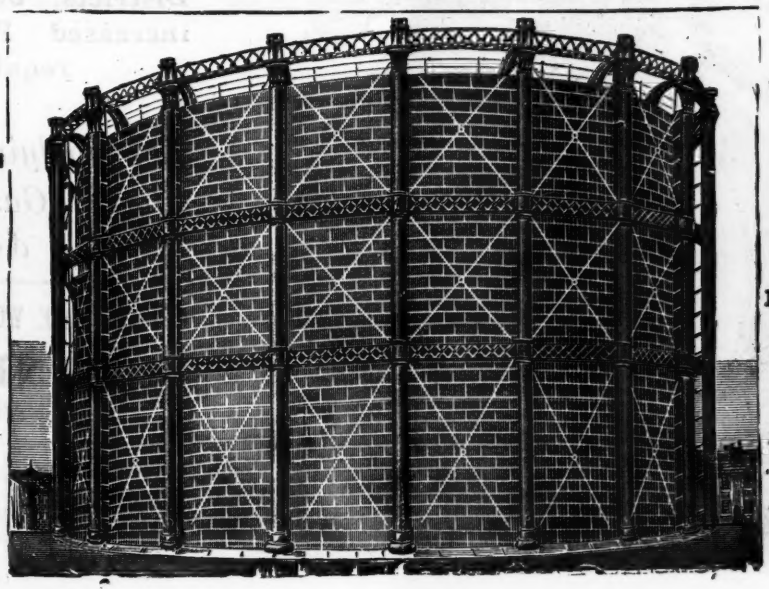

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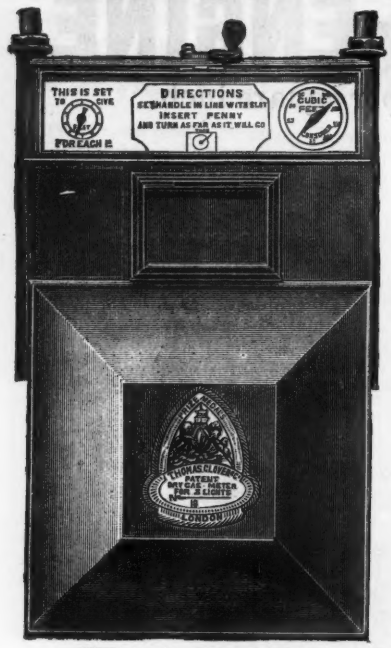

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Simple in Mechanism.
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Price Changer *in Situ.*

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PRESSURE RAISERS

For use in Low-Lying Districts, or wherever increased Pressure is required.

For supplying Cooking-Stoves, Gas-Engines, &c.

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[See also Advt. p. 952.

CONTENTS.

EDITORIAL NOTES:—

GAS, LIGHTING, &c.— PAGE

Views of Theory and Practice in Industry . . . 911
Mr. G. Livesey on Trade Combinations . . . 911
The Southern District Meeting . . . 912
Gas on the Continent . . . 912
Portable Gas Lighting . . . 913

ESSAYS, COMMENTARIES, AND REVIEWS:—

Gas and Water Companies in the Stock Market . . . 913
Electric Lighting Memoranda . . . 913
Professor Fleming's Views on Lighting . . . 914
Micro-Organisms in Water . . . 916

TECHNICAL RECORD:—

Southern District Association of Gas Engineers and Managers—Meeting in London—
General Business . . . 917
Livesey, Mr. F., on Coin Meters . . . 917
Midland Association of Gas Managers—General Meeting in Birmingham—
The Use of Charging and Drawing Machinery in Small and Medium-Sized Gas-Works. By J. T. Lewis, of Wellingborough . . . 921
The Modern Development of the Gas-Engine . . . 924
The Diffusion of Light from Dull Surfaces . . . 927

REGISTER OF PATENTS:—

Protecting Gas-Burners and Preventing Waste of Gas—Dixon, T. . . . 927
Gas or Internal Combustion Engines—Crossley, F. W., and Atkinson, J. . 927
Sprayer for Burning Coal Tar or other Liquid Hydrocarbons—Cowan, W. H. (Peacock, B. H.) . . . 928
Coin-Freed or Prepayment Gas-Meters—Sharp, J. . . . 928
Coin-Freed Apparatus for the Sale of Gas—Glover, R. T., and J. G. . . . 929
Patent Notices . . . 930

CORRESPONDENCE:—

Combinations of Traders in Gas-Works Materials . . . 930
Compressed Gas *v.* Gasholders . . . 930
Illuminating Power and Lighting Effect . . . 931

LEGAL INTELLIGENCE:—

Supreme Court of Judicature—Court of Appeal—Mayor and Corporation of Bradford *v.* Pickles; Interference with a Source of Water Supply by Quarrying . . . 931
High Court of Justice—Chancery Division—East Stonehouse Local Board *v.* Victoria Brewery Company, Limited . . . 932
Court of Session—Bill Chamber—The Corporation of Falkirk *v.* The Falkirk Joint-Stock Gas Company and Others; The Appointment of an Oversman . . . 932

MISCELLANEOUS:—

Meeting of the Imperial Continental Gas Association . . . 933
Bahia Gas Company, Limited . . . 934
The Finances of the Salford Corporation—Local Government Board Inquiry; Sharp Strictures by Mr. Burd . . . 934
The Thirlmere Water-Works of the Manchester Corporation—The Arbitration Concerning the Lonsdale Estates . . . 935
Notes from Scotland . . . 936
Current Sales of Gas Products . . . 937
Coal Trade Reports . . . 937
Gas and Water Companies' Stock and Share List . . . 938

PARAGRAPHS.—Mr. A. Siemens, M.Inst.C.E., 913—Mr. W. C. Jones, 914—Death of Mr. Newton, 915—The New Mayors, 915—Royal Society Medals, 915—Messrs. Cutler's System of Gasholder Construction, 915—Proposed International Exhibition in Amsterdam, 915—Gas-Fires in Hotel Bedrooms, 915—Cement *v.* Pitch Grouting for Pavements, 917—Covering for Steam-Pipes, 917—Institution of Civil Engineers, 920—Increased Use of Water-Meters in the United States, 920—The Petroleum Trade of Philadelphia, 920—Formation of an Association of Yorkshire Students of the Institution of Civil Engineers, 920—Compressed Gas for Locomotive Head-Lights, 920—Society of Arts, 926—Little and Graham, Limited, 930—Accident at the Worcester Gas-Works, 930—The New Water-Works at Sandwich, 931—Bolton Water Supply, 933—Gas Exhibition in Chester, 933—The Dangers of Electric Currents, 933—The Price of Gas at Birmingham, 933—Reduction in Price, 935—Electric Lighting in St. Pancras, 936—Disputed Meter Registration, 936—Electric Lighting in Paris, 937—The Leicester Corporation Water Supply, 937—Accident at the Macclesfield Gas-Works, 937—The Gas and Water-Works Purchase Question at Chesterfield, 937—North Bierley Gas Company and the Local Colliers, 937—The Failure of the Promoter of the British Water-Gas Company, 937—The Water, Gas, and Electricity Accounts of the Bradford Corporation, 937—Sequel to a Gas Explosion, 938—New Water Company for the Weald of Kent, 938—The Charge against a Trade Union Secretary, 938—The Felistowe Local Board and the Water Company, 938—A New Loan for the Sheffield Corporation Water Department, 938—The Purchase of the Barry and Cadoxton Gas and Water-Works by the Local Board, 938—Gas and Electric Lighting at Bolton, 938.

TO CORRESPONDENTS.

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, NOVEMBER 13, 1894.

Views of Theory and Practice in Industry.

THE letter of Mr. C. J. Brown, which was published in our "Correspondence" columns last week, should not be permitted to go without comment; and we regret that pressure on our space prevented us from appending a note to the letter itself. Mr. Brown is pleased to be complimentary in his references to the perspicacity and the perspicuity which are, he says, usually witnessed to, and displayed in our articles. But he roundly accuses us of teaching on a particular occasion an erroneous doctrine, in stating that "practice precedes theory in the world of industry;" and this is a rather serious allegation. Mr. Brown holds that "theory must go before practice," on the ground that no man does a simple piece of work, such as pegging two sticks together, without first having a theory as to what he wishes to do and how to do it. It appears to us, however, that our esteemed correspondent is guilty here of confusing the two essentially different ideas of the *reason* for doing things and the *theory* thereof. A man drives a peg into a wall for supporting an article; the *reason* being that, if not held up, the article will fall down—the *theory* is that of gravitation. When James Watt (or whoever it was) saw in the lifting of the lid of a kettle by the elastic force of the escaping steam a reason for trying to make a steam-engine, he had no theory of the steam-engine, although his reasoning about how such a machine would work was perfectly good and sufficient. We can trace this line of thought still further, and show that, while there is only one immediate and satisfactory reason for doing most things, there may be more than one theory about them, and it may also be long before the rightfulness of any theory is established. A striking illustration in point is supplied by the history of the theories of light. Men made serviceable optical instruments, for good and sufficient reasons, at a time when the only known theory of light was one that has since been demonstrated to be wrong. Our correspondent must see the force of these observations. It is he, not we, who has been misled into assuming that theorizing is the same as reasoning, which it certainly is not. If we entertained any doubt respecting the order of action and speculation in human affairs, we should be satisfied to fall back upon the witness of Principal Caird, who declares that, everywhere and always, "theory comes after the fact which it seeks to "explain" ("The Evolution of Religion," Vol. I., p. 37). Reason, of course, goes with and precedes the action; for if there were no reason why a man, or for that matter an animal, should do a certain thing in a particular way, we may be sure it would not be done.

Mr. Brown appears to make another mistake—he uses the term "theory" as a synonym for "the truth." With him the word "theory" means the truth itself, although in the abstract. A little etymological study would have prevented him from falling into this common error. The term in question comes straight from the Greek *theoria*, a "view." It means, therefore, nothing more than the view which is taken of anything, such as a set of phenomena; and hence it becomes "an exposition of the "abstract principles of a science or art" (Chambers). So that a theory may be true or false, sufficient or inadequate, without forfeiting the name. What Mr. Brown means or wants to say is that the *true theory* of any and all practices in art and industry must be immanent in them. But it does not follow from this proposition, which is indisputable, that a perception of this truth is present to the consciousness of the doer. Perhaps if we put the matter in the order that man thinks, acts, and reflects, and call the fruit of reflection "theory," the correctness of our more briefly stated view, questioned by Mr. Brown, will more easily appear. At any rate, let us hope that the present reference will serve towards redeeming our editorial character for perspicacity and perspicuity, which has, in our correspondent's judgment, been imperilled.

Mr. G. Livesey on Trade Combinations.

THE letter which Mr. George Livesey has addressed to us on the subject of "Combinations of Traders in Gas-"Works Materials" may be expected to create no little stir in certain commercial circles. The writer is known to be a man of his word; and when he says that, rather than submit to what he calls the domination of alleged "rings" of manufacturers of such necessaries as meters and gasholders, he "fully expects" that next year the South Metropolitan Board will "equip a complete meter "factory," and remarks upon the ease with which large gas companies might build their own gasholders, these expressions cannot be regarded by "the trade" as mere declarations of opinion. It must be conceded that, in the instance of the station-meter tenders mentioned by Mr. Livesey, he has a piece of evidence in support of his impeachment of the meter makers which will take a good deal of explaining away, so far as the firms implicated are concerned; and it is inconceivable that he would have said so much about the suspected complicity of gasholder builders in a recent "knock-out" arrangement without having it in his power to say more if needful. It is greatly to be regretted that matters should have come to this pass between the acknowledged head of the gas engineering

profession in the United Kingdom and the "traders," whose guiding principle should be to inspire and preserve in the minds of members of the profession generally a high degree of confidence in their own fair dealing. The meter and gasholder makers will lose more than the South Metropolitan custom if Mr. Livesey carries out his threat, and the Company become self-supplying to the full extent of their ability; for it will be more than gas managers in general dare do to lend themselves to the support of such systems as Mr. Livesey denounces.

The question of the permissibility of combinations of traders is one of degree. We have never favoured in the JOURNAL the abandonment of any interest connected with the gas industry to that "cut-throat" competition which has caused, on the one hand, the ruin of many industries, and has led, on the other, to the establishment of not a few oppressive monopolies. When competition in any trade is carried out to the bitter end of the elimination of the weakest and less favourably circumstanced competitors, the natural consequence is to concentrate the trade in the hands of a few, or of one strong firm; and the last state of the customers of this triumphant survivor is usually worse than the first. Indeed, by his approval, in a modified form, of the late Sir George Elliot's coal-producing scheme, Mr. Livesey himself has shown that he is not averse to the principle of regulating the operations of an industry in the interest of all concerned. His complaint as to the actual or suspected combinations of manufacturers of gas-works supplies is, however, that they so act as to keep to themselves all the natural benefits arising from market fluctuations and improved methods of manufacture which they ought to share with their customers; and that, unless this kind of thing is stopped, they will be tempted to actually discourage improvements in manufacturing methods, and so fossilize and eventually ruin their own trades.

There is not the smallest doubt that, if only the South Metropolitan Directors so elect, they can make their own meters and gasholders and other necessaries as well as they can buy them. Some gas companies already make stoves and meters; and the practice would easily and quickly spread if it were seen to be worth following. The union of gas companies, or corporations, in the promotion of co-operative production undertakings is, however, another matter. The suggestion recalls Mr. William Hardie's paper read before the North of England Association in 1891, which led to a discussion as to whether gas-works could be associated for the treatment of their fluid residuals in a combined way. Several prominent gas managers in the North warmly supported the idea; and Mr. C. Sellers, of York, declared at the time his willingness to propose that a Committee should be formed to consider how far it could be carried out. Nothing came of the notion, however, because it was felt by some managers that statutory permission would be needed for the purpose. Probably the same objection would apply in the present case; but, after all, the difficulty is not insuperable. At any rate, Mr. Livesey's declaration is a note of warning to the traders, which they are not at all likely to disregard.

The Southern District Meeting.

THE members of the Southern District Association of Gas Engineers and Managers had a successful meeting on Thursday last, under the presidency of Mr. H. Smythe, of Maidstone. There was some formal business to be transacted, including the election of six new members, and of Mr. S. W. Durkin, of Southampton, to the chair of the Association for the ensuing year. Three useful papers were read—the first by Mr. Frank Livesey, on automatic prepayment meters; the second by Mr. F. G. Dexter, of Winchester, on the application of incandescent gas-burners to street lighting; and the third by Mr. Durkin, upon the perforation of a gas service by electrical action. Mr. Livesey's paper was admittedly slightly constructed. But it was eminently useful as a candid statement of experience; and it gave rise to an equally instructive discussion. Not the least valuable feature of the debate was its revelation of the very half-hearted way in which, notwithstanding the good examples before them, some gas managers are taking up the popularization of gas in their districts. The old idea of gas as a luxury only fit for people of a certain degree of respectability and means will die hard. However, it will have to go, sooner or later; and the sooner the better. Say what one likes about it, the prepayment meter has hit the taste of a large section of the community which once never thought of using gas; and the best of it is that it is essentially a machine for encouraging the economical use of gas. No forcing of these meters is needed in most places, for when introduced in a few cottages they go of themselves; and it has yet to be realized how important a factor they will become in ameliorating the lot of the poorer orders of our town populations. Before long, it will be recognized that the gas cooking-stove is the necessary, and the coal stove the superfluity, in every artisan's home. Mr. Dexter's paper, which, with Mr. Durkin's, we are compelled to hold over, went to show that what the prepayment meter is doing at one end of a gas company's connection, the incandescent gas burner is doing at the other. The meter is put out of sight in the dwelling of the poor man, but the incandescent burner is its own bold advertisement in the principal streets and thoroughfares of a town; and it would be difficult to say whether the oilman hates the one or the electrician the other with the greater intensity. Last Thursday's papers and discussions will be of material help in furthering the expansion of the gas industry along the two lines which modern inventive ingenuity has opened for it, just when its enemies were flattering themselves that they could perceive in it the earliest symptoms of a much-prophesied decrepitude. Mr. Durkin's communication was of importance not to be measured by its length. It did not, of course, lend itself to discussion, being a statement of pure, but disquieting, fact.

By one of those startling coincidences which occur occasionally to raise the commonplace relations of time and place into a region that seems to border upon the realm of the miraculous, the subject of Mr. Durkin's communication just referred to was illustrated by a remarkable accident in the City on Saturday afternoon. As the incident is reported in yesterday's papers, a brougham was being driven along Cannon Street, and upon making the turn into Budge Row the horse began to tremble violently, and immediately afterwards fell—dying in a few moments. When the driver jumped from his box, he experienced an electric shock. Directly afterwards two explosions occurred simultaneously in two neighbouring junction-boxes of the Electric Lighting Company, doing a considerable amount of damage to surrounding property, and injuring several people. The insulation of the electric light cable took fire, and, as may be supposed, the whole affair caused no little consternation and alarm in the crowded thoroughfare. Naturally, it is reported that "the officials of the Electric Lighting Company have no "doubt that the accident arose from an accumulation of "gas becoming ignited by the electric current." But it will have to be ascertained how the gas came to get into the conduit, and also how it became ignited. Meanwhile, it can only be said of the occurrence that it recalls the Bournemouth accident, with some additions; and it is a fortunate thing that the immediate consequences were not more serious.

Gas on the Continent.

THERE is not usually a great deal in the doings and experiences of the Imperial Continental Gas Association of particular interest for British readers. The conditions under which a company of this kind carries on business are peculiarly its own concern; and its ups and downs are generally connected with what may be termed political vicissitudes rather than consequential upon technical, or even financial, operations. Yet there is something in the recent history of the wealthy and extensive gas-supplying organization presided over in such statesmanlike fashion by Sir Julian Goldsmid that is well worth noting for the light it throws upon the prospects of the gas industry in general. It appears that the sales of gas by the Association for the half year ending June 30 last show an increase of 1¼ per cent. as compared with the output for the corresponding half of 1893. Meanwhile, the number of lights registered as being supplied with gas by the Association increased by 4·8 per cent. The two periods appear to be strictly comparable; there being nothing said of any concessions lapsed or taken up which would vitiate the comparison. It therefore follows, from the statistics given, that while the consumption of gas in all the important European cities served by the Association is still on the increase, the popularity of gas as a means of lighting is growing still faster. This is how we

read the figures in question, which we take to mean that a good many of the additional burners entered upon the books of the Association are of small consumption—that is, they are mainly incandescent or recuperative burners. The incandescent gas-burner as the world now knows it had its birth in Vienna, where is the chief station of the Association; and although it was born, so to speak, a little too soon for its own benefit, there can be no doubt that it is largely in vogue, not only in Vienna but everywhere else upon the Continent. The Association have suffered slightly from the advance of electric lighting in some places; but, like all other gas undertakings, these Continental establishments are discovering that if the first two or three years of electric light competition make a little inroad upon the gas supply, to the extent of checking its rate of growth, this influence is soon outlived, and the increase of the output is restored to almost, if not quite, the normal rate. It would be interesting to know whether there is any connection between the comparative prices of gas and electric supplies on the Continent and their popularity. We do not believe that any such connection exists. Notwithstanding the cheapness of incandescent electric lamps in most European countries, electric lighting is generally expensive. Neither is gas so cheap as it could be rendered if the concession system were modified so as to make this the chief object. However this may be, the fact remains that, in the experience of the Imperial Continental Gas Association, gas still more than holds its own on the Continent, against all competitors and under all disadvantages; and there is no apparent reason to expect any change in this satisfactory condition of affairs.

Portable Gas Lighting.

In our "Correspondence" columns to-day will be found another letter on the interesting subject of storing gas in compression cylinders accessory to, or in substitution for, the usual method of storing it in gasholders under low pressure. It is to be hoped that those of our readers who have had experience of compressing coal gas of ordinary quality for purposes of transport and lighting will not allow the present opportunity to pass for putting their knowledge on record. Several well-known names in the profession might be cited in this connection; but we trust they will take this hint, and speak on it without needing a more particular appeal. So far as our knowledge of the subject goes, it is that no attempt, although several have been made, to light railway coaches by means of compressed common coal gas, has been lastingly successful. All the expenses of compression and transportation, and all other labour charges, are the same for ordinary coal gas as for the richest oil or cannel gas; while, of course, the superior illuminating value of the richest gas renders these charges less crushing than they are in comparison with poor coal gas. For railway purposes especially, that is the cheapest as well as the best gas of which a very little goes a long way. And there is the additional advantage that the rich oil gas burns best with the small burners which are alone suitable for railway-carriage lighting. Hence not even cannel gas has been able to hold its own in England against oil gas for application to the lighting of railway trains; although what is styled "Boghead gas" is carried about in the neighbourhood of Paris, and sold to sufficient advantage to keep the industry alive. Ordinary coal gas suffers a considerable depreciation of illuminating power by compression even to two or three atmospheres. If compressed to eleven atmospheres, it might not suffer much more, although, in the absence of reliable data, it is impossible to speak definitely upon this head. We should imagine, however, that if 15 or 16 candle gas were put into the compression cylinders and kept for a few days at the pressure already mentioned, it would not be much more than 12 or 13 candle gas when allowed to come out again. In order to burn this gas to advantage, it would be desirable to use an incandescent burner. The subject is one that should arouse an interesting discussion, if only those engineers who know all that is known about it will take the trouble to look up their old note-books, and make public a few of the facts therein buried.

Mr. A. Siemens, M.Inst.C.E., has accepted the presidency of the Institution of Junior Engineers (formerly the Junior Engineering Society) for the session 1894-5, in succession to Mr. J. Wolfe Barry, C.B.; and he will deliver his Inaugural Address next Friday evening at the Westminster Palace Hotel.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 933.)

The aspect of affairs on the Stock Exchange has not undergone any material change during the past week. The markets in general have ruled quiet; and, on the whole, they may be written as only moderately firm. Incidents occurring in the week which might be calculated tc affect prices have been few; and these are confined to railway interests. The home market was somewhat depressed by the Great Northern issue; while the long-suffering American became rather more cheerful, in view of the result of the elections. Business, however, all round has been much restricted. The gilt-edged class still have the best of it; and anything really good almost commands its own price within reasonable limits. The Money Market was rather more active; and the settlement this week will afford it a modicum of assistance. The Gas Market was rather more active; and everything dealt in was remarkably firm, although there are fewer advances in value to record than there have been each week for a considerable time past. Gaslight issues of all sorts were very brisk. The "A" was largely dealt in every day, and at the most even figures—never varying more than a fraction above or below 250. The second issues were particularly strong; some of the debenture and preference stocks changing hands repeatedly at the highest figures. South Metropolitans were fairly busy; and each issue dealt in commanded an excellent price. Commercials were quite stagnant for want of stock. Suburbans and Provincials were a good deal more to the front than usual; and certain stocks were dealt in which rarely come into the market. This class is coming more and more into favour; and some of the issues are among the choicest and highest priced in the list. Considerable increases were made by both Crystal Palace and Tottenham. The Continentals were not particularly active; but prices in general were good. Among the rest, Monte Video and Oriental advanced to a moderate degree. Bahia now drops out of our list; the Company having handed over their works to the Government, and being in course of liquidation. Business in Water was quite active; and everything fetched high prices. The run on debenture stock is more marked than ever.

The daily operations were: The Gas Market opened lively, and was strong and active all day. Crystal Palace rose 3; and Monte Video, ¼. New River debenture gained 2. On Tuesday, business was quieter; but everything was very firm, although unchanged. Southwark "D" rose 1. Wednesday also was a quiet day; and quotations did not vary. Business on Thursday was even more limited; and still Gas quotations did not move. In Water, New River advanced 1¼; and Southwark ordinary, 1. On Friday, there was some resumption of activity, with good prices; but the only move was a rise of ¼ in Oriental. Saturday was unusually brisk, but without change; and quotations closed without further alteration.

ELECTRIC LIGHTING MEMORANDA.

Electrical Traction at the Institution of Electrical Engineers—Over-Competition in the Electrical Industries—Professional Etiquette among Engineers—The Heating Capabilities of Electric Incandescent Lamps.

The opening meeting of the winter session of the Institution of Electrical Engineers was held on Thursday last at the Institution of Civil Engineers, under the presidency of Mr. Alexander Siemens. Two papers were read, both dealing with electrical traction. The author of one of these, Mr. H. D. Wilkinson, has made a study of the trolley-wire systems of tramcar propulsion as developed in the United States and in Canada; and he takes the position that while this kind of electric traction is impossible for our own already too crowded main thoroughfares, lines could be advantageously adapted to such a system in the wider and less frequented roadways. Mr. Wilkinson thinks, for example, that a trolley-wire system with cars running every two minutes might be combined with the electric lighting of the Victoria Embankment; and he "respectfully submits this to the London County Council." It is not too much to say that if ever such a degradation of the finest riverside roadway in the world were really to come before the County Council, it would in all probability be thrown out with anything but respectful comments. It is easier to agree with Mr. Wilkinson when he remarks that, "if facilities for reasonably quick and cheap travel between the suburban districts of our large towns and outlying villages were afforded the masses, they would gladly avail themselves of them." This is true enough; but, unless we are greatly mistaken, it is not this description of traffic that maintains the trolley-wire tramways in the States. According to the authors of the second paper read at the meeting, six hundred electric tramways are in operation in the United States, representing 9000 miles of rail, equipped with 20,000 cars, and involving a capital investment of £45,000,000. "These facts," said the authors, "could not but appeal pleasantly to the electrical engineer." The wonder is how any electrical engineer can reconcile himself to the idea of dragging out a miserable existence in a country which is so benighted as to care nothing for the trolley-wire system of tramcar propulsion.

While the members of the Institution of Electrical Engineers are having their ears tickled by, and their mouths made to water over, accounts of the progress of electrical traction on the other side of the Atlantic, their minds must continually recoil upon the consideration of the unsatisfactory state of their profession in this country. The electrical journals have of late been full of the bitter cries of outcast electricians, who have been cut out of berths and work by what they call the unprofessional conduct of unnatural brethren. The question has arisen in this connection, not only of what constitutes professional etiquette, but as to whether there is any etiquette of the kind at all between electricians engaged in the life-and-death struggle for shares in an amount of work which is not enough to go round. It is the same story in all divisions of the trade. The professors who once "raked in" their thousands a year for reporting upon electrical schemes for the guidance (?) of possible investors, have little temptation nowadays to exhibit their skill in steering close to the wind in these professional exercises. The consultants of some reputation have fallen upon the days of small things in municipal ventures; and the lower rank and file of electrical experts have to fight tooth and nail for very thin appointments. As for the makers of electrical appliances, and contractors for house-wiring, the prices at which contracts go are not merely unremunerative, they are simply impossible for firms who are not desirous of heading straight for the Bankruptcy Court. Where is the room for professional etiquette in such a chaos? It is as much as can be reasonably expected if common honesty is not crowded out of the electrical world.

The truth of the matter which constitutes the basis of the preceding paragraph is that professional etiquette has always been a vague quantity in the various branches of the profession of engineering. There have never been lacking in this profession numbers of magnanimous souls who would scorn to seek their own advantage by any means which might work to the detriment of others. But it is only too notorious among engineers that many men calling themselves "professional gentlemen" have elbowed themselves to the front, and still do so, with utter disregard of everything that might be recognized for fairness as between man and man—to say nothing of such courtesy as is supposed to regulate the mutual relations of members of the closer professional orders. Civil engineers have often behaved very uncivilly towards one another, in intercepting commissions, depreciating competitors, and underbidding for work. Nothing is too mean for some grasping engineers, whose competency nobody denies; and the amount of "log-rolling" that goes on in and about Great George Street is incalculable. There is no special reason why the electrical branch of the profession should be exempt from these evils, if indeed it has not laid itself open to them in aggravated intensity by the rashness (to call it by no harsher name) with which the early practitioners took premium pupils in numbers altogether disproportionate to the requirements of the industry. Now the superfluous pupils who do not happen to be wholly inefficient are revenging themselves on their quondam employers; and the trade in general has gone to pieces through over-competition before it could be said to have attained to a full commercial development.

As things are going now, the electricians will soon have to abandon their old plea that the incandescent electric lamp is a source of light without heat. Users of the lamps have long since discovered the fallaciousness of this claim, and are fully aware that there is a peculiar "stuffiness" in electrically lighted apartments unless the ventilation is quite as good as would be required if gas were employed for lighting. The last blow is given to the illusion by the fact that incandescent lamps are adapted by certain patents for boiling water and keeping tea and coffee pots hot. A well-known Sheffield firm of electro-platers have put upon the market some very neat hot-water jugs and tea-kettles made to be heated by the introduction of incandescent electric lamps into their interior, by means of a hollow bottom and a suitable table stand. Illustrations of these appliances for the up-to-date breakfast and tea table are circulated, showing the jugs and kettles steaming away over the lamps, which may be of 8, 16, or 50 candle power. The largest lamp will boil 2½ pints of water in 25 minutes; and the smaller sizes will keep water at the boiling-point. This is all very nice; and doubtless a few of the new kettles will make their appearance upon lecture tables, and perhaps in smart residences, situated in electrical supply areas, where the presiding divinities have a fancy for novelties, and the means of gratifying it regardless of expense. It may, however, be doubted whether the advantage to electrical supply companies derivable from this new application of incandescent lamps will outweigh its effect as an exposure of the popular error that there is no heat in this system of lighting.

Mr. W. C. Jones, Assistant-Manager at the Birstall Local Board Gas-Works, has been selected by the Directors of the Brierley Hill District Gas Company to fill the position of Manager of their branch works at Kingswinford, near Dudley, in the room of Mr. H. R. Coles, who has been appointed Distributing Engineer to the Cork Gas Company. The appointment obtained by Mr. Jones was advertised in the JOURNAL for the 16th ult., under No. 2439.

PROFESSOR FLEMING'S VIEWS ON LIGHTING.

As we announced last week, the matter of the course of lectures on "Electric Illumination" delivered by Professor J. A. Fleming to afternoon audiences at the Royal Institution, with some additions, has been published in the form of a pretty, not to say showy, book by *The Electrician* Printing and Publishing Company, Limited. We have no hesitation in recommending all who may be interested in the subject to buy a copy of Professor Fleming's book, which is well worth the price asked for it; being fresh as regards matter, and abundantly provided with illustrations which are also more or less original. It is not our intention to review Professor Fleming, regarded as an authority in electrical science. We are content to take him for a competent teacher of a wide range of subjects with which we possess only a nodding acquaintance; and what we propose to do in the present article is merely to put our readers in possession of his views respecting certain matters in which electricians and gas engineers may be said to have a common interest. We have been sorely tempted to discuss some of these points as extracts from Professor Fleming's lectures have appeared in the columns of the *Electrician*, but have reserved ourselves for the opportunity presented by the publication of the complete set in the promised book form. For while admitting the author's competence to discourse instructively respecting the principles of electricity and magnetism, we cannot allow him any special credit as an authority upon many points of lighting practice in regard to which electricity has to rank as one among many available means for subserving the same end.

Speaking of the comparative efficiencies of various sources of light, Professor Fleming states that the ratio of the luminous to the total radiation varies very little as between the candle and the Argand gas-lamp, or even the incandescent electric lamp. In the candle-flame, this is from 2 to 3 per cent.; with the Argand gas-flame, it is 4 per cent.; while with the incandescent electric lamp, it may range from 3 to 7 per cent. Of course, Professor Fleming knows that in this comparison he has not included the most efficient way of burning gas for lighting; but he says nothing about it. He declares, in this connection, that "one great problem awaiting solution in the future is the discovery of a source of artificial illumination which is, relatively speaking, much more efficient than those which are at present available; that is to say, of a method which will convert a greater proportion of the energy which is transformed into radiation strictly limited to that which can affect the eye." Professor Fleming's style is not particularly felicitous, as this passage shows; but it is easy to understand what he means. He looks for the cheap light of the future in the development of phosphorescence—which is a pretty long hope; but he testifies to the remarkable circumstance that, in the opinion of one prominent electrician, "the light of the future" is more likely to be chemical than electrical. The question of light efficiencies leads Professor Fleming on to the subject of photometry, which he confesses to be in a less satisfactory condition than practical electrical measurements generally. After describing the parliamentary standard candle, he goes on to tell how simple photometrical observations can be made by the help of a "Ritchie's wedge," or by the shadow method. These methods serve as means of giving the amateur an insight into the difficulties of photometry; but Professor Fleming knows, and does not omit to state, that the statutory photometry method is that of the Bunsen grease-spot screen. With regard to standards of light, Professor Fleming confesses to a preference for the pentaen standard of Mr. Vernon Harcourt.

When describing incandescent electric lamps, the author draws attention to, and illustrates, "a form of lamp called a candle lamp, employed for decorative and other purposes;" and it says little for his taste that he does not denounce the sham for the stupid "hideosity" it is. Having discussed the various considerations that enter into the question of the usefulness of incandescent electric lamps as sources of light for ordinary purposes, Professor Fleming arrives at the conclusion that the question which is so commonly asked, as to whether electric light is cheaper than gas, cannot be answered by a simple "Yes" or "No." The factors which decide the relative cost, so far as the electric lamp is concerned, are: (1) The price of the unit of supply; (2) the price of the lamp; (3) the average useful life of the lamp, which depends not only upon the lamp itself, but also upon the constancy of the electric pressure of the supply; (4) the manner in which the wiring of the building has been done; (5) the distribution of the lamps so as to obtain the utmost lighting value from every one, and the care shown in switching off current when not required; (6) the degree of cleanliness in which the lamps are kept. Professor Fleming gives a table from which the cost of current and lamp renewals at various rates of charges can be ascertained. "It is obvious," he remarks, "that no hard and fast comparison with the cost of equivalent candle-hours by gaslight is possible, unless a careful statement is made of the manner in which the two lights are used." The only statement offered upon this head is an assertion that "actual extended experience shows that, with care and good management, electric energy at 8d. per unit can be made to give as much illumination by means of incandescent lamps as gas at 3s. 2d. per 1000 cubic feet used with ordinary burners. At this rate, one Board of Trade unit of electric

energy can be made to do the work of about 200 cubic feet of gas." It would take more than a single example to prove the general validity of this comparison.

Proceeding to deal with the employment of incandescent electric lamps in such a manner as to produce the best illuminating effect, Professor Fleming lets us see him in the character of a scientific lighting expert. He begins by laying down the law that, "while a proper and sufficient illumination is thrown upon the surfaces to be illuminated, the source of light must be itself, as far as possible, concealed." This dictum is just in a general way; but it needs to be intelligently applied. "The illuminating power of a light for the purpose of vision does not depend merely upon the candle power of the lamp, but it depends upon the amount of light which is received by the eye from the surfaces from which it is reflected." This also is true enough; and the same may be said of the observation which follows, to the effect that the eye is dazzled by the filaments of incandescent lamps when these are employed, without screening, to light an interior. "If, however, the lamp-globes are made of frosted glass, or in other ways protected, so that the image of the incandescent filament cannot be directly thrown upon the retina, the actual visual effect may be increased in spite of the fact that such frosted globes or screens may cut off from 30 to 50 per cent. of the light." This is "illuminating power" contrasted with "lighting effect" again. Professor Fleming while admitting that a lamp is better for seeing by when covered with a ground glass or porcelain shade, denounces the practice as a wasteful one, because there can be no object in making light merely to absorb it. We may remark, in parentheses, that this objection does not apply so forcibly to the case of gas-burners screened along the direct line of vision by means of ground or porcelain glass globes, inasmuch as these are always open to the ceiling, which plays a conspicuous part in diffusing the light in a room.

Professor Fleming's suggestion for overcoming the difficulty in regard to incandescent electric lighting is that "the lamps may be placed in shades, so as to throw the light upwards upon the ceiling of the room or upon the walls, from which surfaces it is ultimately reflected down on to the objects in the room. . . . It is always possible to arrange glow lamps, protecting them by metallic or other ornamental shields, so as to obtain this desired effect. A natural shell, properly supported, forms a very effective screen and reflecting surface. The white pearly interior acts as a reflecting surface; and if the shell is very slightly translucent, then a *pleasing effect* is produced by a small and diffused light which passes through." The italics are ours. Tastes proverbially differ; but we venture to assert that whoever saw with approval the trumpery, tea-garden like effect of the employment of natural shells in the fashion here recommended, as displayed at the last Crystal Palace Electrical Exhibition, must have had an oddly perverted æsthetic sense. Moreover, it is, or should be, obvious that the use of metallic or other opaque screens in conjunction with any means of lighting is to follow the fashion of footlights, which fashion is of limited application. Speaking with reference to the lighting of ordinary living-rooms, opaquely shaded lamps are of all things most irritating, and should never be introduced anywhere unless it is desired to concentrate a specially brilliant lighting upon a particular object. It is one thing to screen the incandescent filament of an electric lamp, or the naked flame or incandescent mantle of a gas-burner from dazzling the eye, and quite another thing to make a mystery of the means of lighting. Either extreme is inartistic.

It is greatly to be regretted that Professor Fleming, in the middle of what he intends to be an instruction in decorative or "artistic" lighting, should have again dragged in the miserable "candle lamps" already mentioned. To show how hopeless he is in this way of offending, he calmly describes how "these candle lamps are carried on the extremity of an artificial porcelain candle, so as to resemble in some degree an ordinary wax candle alight!" And then he goes on to describe an example of lighting in which the designer, not content with commiting this abomination in art, has hidden them from sight, as candles were never hidden. Or was this latter idea due to a glimmering sense of shame in the designer, which impelled him to conceal "his crime?" At any rate, Professor Fleming stamps himself by approving the use of these monstrosities; for there is no sense of what is fitting in art in a man who fails to see that truth to nature and avoidance of shams is the very foundation of art.

We have no wish to be hard upon Professor Fleming, however, who has probably only gone wrong upon this point through sheer inadvertence, after having quitted his proper sphere. The manufacture of "candle lamps" is a barbarism for which he is not responsible. Regarded in one aspect, these things are an interesting illustration of the well-recognized tendency of mankind to mould new things into some sort of likeness to the old, which in another department of modern industry caused the builders of the first railway carriages to make their productions as nearly like mail coaches as was possible under the novel conditions. Again, modern mechanical industry and inventiveness is far livelier and more fruitful of novelties than is modern art; so that it is easier for the men of the present day to bring out a new system of artificial lighting than it is for other men to endue the novelty with a truly artistic embodiment. If there is no modern style in domestic architecture, how can there be modern art in domestic lighting arrangements? If an architect is commissioned to design a new house, he can do no better than repeat some old type, in connection with which even gaslighting looks preposterously new and crude; so it is vain to look for perfectly satisfactory electric lighting fittings. All the same, there is no excuse for "candle lamps," the appearance of which, shamelessly stuck on the top of artificial candles, in a room, is enough to provoke one to take shots at them with a saloon pistol.

It only remains to acknowledge the painstaking way in which Professor Fleming has explained the phenomena of arc lighting, and the arrangements of central stations. As we commenced this article by stating, the book is worth buying for a guide to a fair general knowledge of the principles which underlie the industrial uses of electricity. We can also compliment the publishers upon the way in which the volume is turned out.

Death of Mr. Newton.—The death is announced of Mr. Newton, of the firm of Messrs. George Orme and Co., of Oldham. Mr. Newton died very suddenly, at his residence, last Tuesday, the 6th inst.

The New Mayors.—Among the new Mayors elected last Friday, were Alderman Grandidge, for Pontefract; Alderman A. E. Lloyd, for Manchester; and Sir David L. Salomons, for Tunbridge Wells. The first-named gentleman is a Director of the Pontefract Gas Company and the Chairman of the Askern Gas Company; Alderman Lloyd is a member of the Water Committee of the Manchester Corporation; and Sir D. L. Salomons is closely connected with the electric lighting industry, and is the author of several works thereon.

Royal Society Medals.—The President and Council of the Royal Society have this year awarded medals as follows: The Copley Medal to Dr. Edward Frankland, for his eminent services to theoretical and applied chemistry; the Rumford Medal to Professor James Dewar, for his researches on the properties of matter at extremely low temperatures; the Davy Medal to Professor Cleve, of Upsala, for his researches on the chemistry of the rare earths; and a Royal Medal to Professor J. J. Thomson, in recognition of his contributions to mathematical and experimental physics, especially to electrical theory. Her Majesty has signified her approval of these awards.

Messrs. Cutler's System of Gasholder Construction.—The Municipality of Copenhagen recently decided to construct a three-lift gasholder at their eastern works, and accordingly invited tenders, including designs, for the work. Having considered the numerous offers submitted, they have awarded the contract to Messrs. S. Cutler and Sons, of Millwall. The guide-framing is to be on their patent spiral system, and is to be carried up the complete height of the three lifts. In connection with this matter, it may be mentioned that we have received a copy of a small album of photographs of holders constructed by Messrs. Cutler, in which several examples are given of this system of guide-framing, particulars of which are furnished.

Proposed International Exhibition in Amsterdam.—A project is on foot to hold in Amsterdam, from May to November next year, what is called an "International Exhibition of Hotel and Travelling Accommodations," under the patronage of H.M. the Queen-Regent of the Netherlands. It is expected that the exhibition will be a great success, as already large promises of support have been received from different countries. There will be sections for lighting and heating; and consequently scope will be afforded to English manufacturers of appliances in connection therewith for making their goods known in Holland. Facilities will be given for showing cooking and heating apparatus in action; and as, owing to the low price charged, gas is very generally used in Holland, the forthcoming exhibition should be the means of further extending its usefulness in the household. The Executive Committee, of whom Mr. N. A. Calisch is the President and Mr. F. Foekens the Secretary, will have the help of a Committee composed largely of experts, of which Mr. H. Salomons, Manager of the Amsterdam works of the Imperial Continental Gas Association, is a member.

Gas-Fires in Hotel Bedrooms.—Writing on the subject of gas-fires, and the want of a coin-freed tap, in the JOURNAL for Sept. 19, 1893, we referred to a question which had reached us as to why somebody did not "bring out a coin-controlled gas-fire for fixing in hotel bedrooms, whereby the cold and weary traveller might help himself to an hour or two of warmth without all the trouble and delay of getting a fire lit to order." The idea was taken up—we cannot say seized upon—and, just twelve months after the suggestion was made (see *ante*, p. 571), we recorded the fact that it had been adopted in a Liverpool hotel. We have now before us, in the form of a neatly-printed circular issued by Messrs. R. and A. Main, of Glasgow and London, a proof that they are prepared to assist hotel proprietors in adding to the comfort of their patrons in the direction alluded to. They indicate the best method of fixing the fires (of which several specimens are shown), and point to the economy in labour their adoption would effect. We feel sure that a notice in a hotel bedroom that the occupant could have a bright, cheerful fire at any time, day or night, without having to call up domestics, at a charge of 6d. an hour, would induce many to avail themselves of the privilege, especially in winter.

MICRO-ORGANISMS IN WATER.

THE volume produced by the joint authorship of Dr. Percy Frankland and Mrs. Percy Frankland, treating of bacteriology as connected with the sanitary aspects of water supply,* is eminently suited to the wants of the present period, and cannot fail to be accepted as a standard work and valuable text-book on the subject to which it refers. The explanations are lucid, and the principles involved are admirably demonstrated. The treatise is at once philosophical and practical. It covers a wide area of research, and is well adapted to fulfil its professed design—that of rendering service to those who have to deal with the supply of water as an agent of sanitation. A brief "Introduction" points out the momentous results that have followed the development of the germ theory of zymotic disease, and specifies how, in a period no longer than a quarter of a century, there has been a complete revolution in the views of scientists as to the causes which affect the quality of drinking water. At one time the chemical test was regarded as everything. In accordance with Liebig's theory of the phenomena of fermentation, it was supposed that decomposing organic matters, if present in the water supply, would tend to set up putrefactive and other injurious changes in the digestive organs with which they were brought in contact. It was reserved for Pasteur to show that the processes of fermentation and putrefaction were due, not to decomposing organic matter, but to living organisms, and that these organisms were certainly the cause of some zymotic diseases, if not all. Hence the presence of organic matter in water became a secondary consideration; primary importance being attached to the effect of micro-organisms possessed of vitality. The path thus entered upon led to discoveries of the highest interest, largely affecting sanitary science. The methods of investigation devised by Koch gave a command of facts which rendered bacteriology at once fascinating and practical. Thus in a few years the analysis and examination of water underwent an absolute change. Perhaps in no instance are the practical effects more distinctly seen than in the case of the Metropolitan Water Supply, which has thus been rescued from undeserved suspicion, while at the same time the process of purification has been explained and perfected. The value of filtration has been clearly demonstrated, and vague apprehensions have been dissipated by the exhibition of precise and definite facts, founded on irrefragable data. The civilized world may be congratulated on the substitution of the germ theory for that of mere organic decomposition.

It would be an error to suppose that the phenomena connected with the presence of micro-organisms in water are now so well understood as to leave nothing more to be learned. We know enough to believe that the experts are on the right track, and that certain principles have been worked out which can be depended upon. But we cannot suppose that the novelties have been exhausted, or that more may not be looked for. Still it is a fact that the bacterioscopic test, in its present form, has presented itself at a critical moment, showing how we can be assured of a wholesome water supply for an ever-increasing urban population. The problem would have been a source of despair had it continued to rest where chemistry had placed it. Natural processes now prove more beneficial than was supposed, and artificial means are found to supplement these far more effectually than was thought possible a few years ago. In respect to the water supply, it may be said that we now know where we are, and have every reason to feel encouraged. The state of the case was very different a short time back. Chemical analysis showed that sand filtration effected only a very slight improvement in river water; the matters in solution undergoing but little diminution. This method of purification was first practised in connection with the London Water Supply in 1839; but, although it rendered the liquid clear and bright, there was still an apprehension that the elements of disease were not arrested. In 1885, Dr. Percy Frankland introduced into England Koch's gelatine process of water examination, and applied it to the water supply of the Metropolis. The astonishing effect of sand filtration, as practised by the London Water Companies, was thus rendered apparent for the first time; the reduction in the number of micro-organisms being shown to amount in some cases to very nearly 99 per cent. At the request of the Local Government Board, regular bacteriological examinations were made by Dr. Percy Frankland in the years 1886-7-8; and the average reductions were found to range between 95·3 and 98·4 per cent. as between the number of micro-organisms in the river waters and in the water drawn from the filter beds. Such were the results obtained in the case of the Metropolitan Water Companies taking their supply from the Thames or the Lea. The water of the New River Company is not included, nor that of the Kent Company. In 1892, a most searching examination into the efficiency of the filtration practised by the London Water Companies showed that out of 61 samples of filtered water collected at the several works, there was but one which contained more than 100 colonies of microbes per cubic centimetre; the average number being only 29. There is also reason to be believe that in such cases the majority of the bacteria in the filtered water are due to post filtration sources. The filtering media themselves are not sterile; nor are the channels, culverts, or wells.

Some remarkable phenomena appear in respect to the multiplication of micro-organisms. Water containing only 7 colonies of microbes per cubic centimetre was taken from one of the deep chalk wells of the Kent Company. After the water had been standing for one day, at a temperature of 20° C., the colonies became 21; and in three days they were 495,000. By way of explanation, it is argued, with every show of reason, that, the water being originally almost wholly free from microbes, the ingredients necessary for the sustenance of such organisms were entirely untouched, and were therefore available as a food supply, while the contrary would be the case with water taken from a river. With Loch Katrine water subjected to a temperature of 19° C., Dr. Percy Frankland found the bacteria increasing from 74 to 42,537 per cubic centimetre in six days. At a temperature of 9° C., the rate of increase in the same period of time was only one-third of that observed at the higher temperature. The example is instructive as occurring in the case of "pure moorland water," though the Kent example is still more marvellous. Stranger still is the multiplication of microbes in sterilized distilled water, where every particle of organic matter seems to be wanting. But in all these cases, while there is a rapid increase of microbes for a time, there is afterwards a diminution. Water taken from the Lake of Zurich had 12,457 micro-organisms per cubic centimetre at the end of 24 hours. In three days there were 328,543; but in seventy days there were only 2500. The rapid multiplication of bacteria in the earlier stage, even when a low temperature is observed, is adverted to by Dr. Percy Frankland as clearly indicating the inadmissibility of delaying the bacteriological examination of a sample of water beyond a few hours, "even if the sample be packed in ice."

The detection of pathogenic bacteria in water forms an important chapter in the work. There is some consolation in the circumstance—if we may trust to it as having a correct foundation—that the only human diseases of the zymotic class which are commonly believed to be propagated by water are Asiatic cholera and typhoid fever. It is singular that these two forms of disease are apparently unknown among the lower animals. The vulgar maxim that "what is one man's meat is another man's poison," seems to find some exemplification in the circumstance that certain bacteria are pathogenic to the lower animals but not to the human species, while the bacteria of the two probably most virulent diseases among mankind are non-pathogenic to the brutes. As the microbes of cholera and typhoid are powerless against animals, their presence is only to be detected by the laborious method of artificial cultivation. An incident recently recorded in the newspapers of the day seems to illustrate this point. As if impatient of the artificial method, a foreign scientist lately experimented on some suspected water by swallowing a portion of it; his zeal in the pursuit of knowledge costing him his life. Had the infected draught been given to a guinea-pig, we must suppose that no indication of the cholera microbe would have ensued. The authors of the work now before us state the difficulties which present themselves in the application of the artificial process. Owing to the preponderance of the common water bacteria, the ordinary plan of gelatine-plate cultivation will only lead to the detection of the pathogenic forms in the most exceptional cases; and it has been necessary to devise special methods in which the growth and multiplication of the pathogenic microbes is favoured and stimulated, while the development of the other bacteria is either retarded or altogether suppressed. We are told it is precisely in connection with such special methods for the discovery of particular forms that some of the most important advances have recently been made in the bacteriology of water. Both in the case of the typhoid bacillus, and that which is identified with cholera, much difficulty is experienced in recognizing the particular microbe among a crowd of other bacteria. The methods employed for this purpose are carefully described, as also the process devised "by one of us" for the detection of anthrax spores when present along with other micro-organisms in water.

The vitality of particular pathogenic bacteria in different waters has been the subject of experiments conducted on the plan of introducing the organisms into such waters, and then subsequently estimating their numbers at suitable intervals. It is found that the typhoid bacilli will retain their vitality in sterilized water, even if it has been distilled, for considerable periods of time—at any rate, for upwards of a month. With regard to unsterilized water, much of the work done is said to be unfortunately quite unreliable, though it is here that the results have the greatest practical importance. In connection with the vitality of the cholera bacillus in water, some recent investigations made by Trenkmann are referred to as possessing considerable interest. In these researches, varying doses of different salts were added to a particular well water kept at a certain temperature. The cholera bacillus was then introduced, and its subsequent behaviour carefully watched by means of plate cultures. In unsterile well water, the addition of sodium chloride greatly stimulated the vitality of the water bacteria; so much so that when only a very slight addition was made the cholera bacilli were nearly overwhelmed by the others. Yet with larger additions of salt, these bacilli were made more capable of resisting

* "Micro-Organisms in Water: Their Significance, Identification, and Removal." By Percy Frankland, Ph.D., F.R.S., and Mrs. Percy Frankland. London: Longmans, Green, and Co.; 1894.

their antagonists. These results are compared with the circumstance that the cholera organism has been found capable of living for long periods in brackish water, such as the harbour water at Marseilles. So also the Hamburg water supply, during the cholera epidemic of 1892, was found to be distinctly brackish in character. It is now a matter of knowledge that the cholera organism is placed at the greatest advantage, when a high percentage of salt is present. Hence the particularly brackish condition of the Elbe during the cholera epidemic of 1892 is of special interest and importance. The circumstance that the water taken from the Thames for the supply of London is derived from a source above the tidal influence, is thus a defence to the Metropolis as against an invasion of cholera. Researches with regard to other pathogenic microbes serve to show how, in the case of unsterilized waters, the ordinary water bacteria are able to overwhelm and suppress the foreign pathogenic forms which have been introduced. Hence the general mass of ordinary microbes, in their hostility to the pathogenic, take rank as the friends of mankind.

A very striking chapter has reference to the action of light on micro-organisms in water and culture media. The subject is properly described as one of "immense importance in connection with the vital phenomena of bacteria." The bactericidal effect of light was first demonstrated in 1877; and it has since been found that, while the red and orange-red rays of the spectrum delay the development of bacteria, the blue and violet rays entirely prevent their growth. A systematic series of experiments on the bactericidal action of light on organisms in water has been made by Dr. Percy Frankland. Among the operations was one in which sporiferous anthrax in unfiltered Thames water became extinct after 84 hours of exposure to direct sunshine. Other experiments were of a similar character. In a further series, the virulence of the organisms was tested by subcutaneously injecting the liquid into mice. It thus appeared that, in waters exposed to direct sunshine for 151 hours, the anthrax germs were completely destroyed. A singular discovery was incidentally made some time ago by Arloing; showing that anthrax cultures, after exposure to sunshine for about 30 hours, were not only less virulent when inoculated into animals, but acted under such circumstances as a sort of vaccine. Notwithstanding the encouragement to be derived from these experiments, we are warned that "there has been a considerable tendency to magnify and exaggerate" the bactericidal agency of sunlight. Accordingly we are admonished that, "whilst every opportunity should be afforded for insolation in the construction of water-works, undue reliance must not be placed on this any more than on any other particular bactericidal agency."

We do not profess to have discussed all the topics contained in this interesting book. We have avoided numerous matters of detail, and have endeavoured to give as clear an outline as possible—presenting the more salient of the facts. There is a valuable appendix of considerable extent, giving a precise description of the principal characters of all the micro-organisms, which, so far as the authors have been able to ascertain, have hitherto been found in water. These are more than 200 in number. The names of the organisms pathogenic to man or animals are printed in red, and a careful classification has been observed throughout. The text is also aided by illustrations; and at the close there is a useful index.

Cement v. Pitch Grouting for Pavements.—The Engineer and Surveyor for St. Pancras (Mr. W. N. Blair), in the course of a report to the Vestry, deals with the relative merits of cement and pitch grouting for paved streets—strongly favouring the latter. The cement grout requires a joint at least $\frac{1}{4}$ inch wide, as against $\frac{1}{16}$ inch for the pitch. When the blocks expand through damp, the cement, being rigid, cannot give, and thus it very frequently displaces the kerbs. They require to be left a week before traffic can be admitted on a section in which they have been used; while with pitch the traffic can be admitted immediately on completion. On the other hand, cement joints can be run in any weather, wet or dry; whereas with pitch the blocks must be dry. The difference in cost is also slightly in favour of cement.

Covering for Steam-Pipes.—At one of the regular meetings of the Engineers' Club of St. Louis, Mr. J. A. Laird communicated the results of some experiments recently conducted by the Water Department of that city to determine the efficiency of various forms of steam-pipe covering. Chemical analyses were first made of each covering. Tests were then conducted —first, by noting the condensation per hour in a 10-feet length of 1-inch pipe, to which the covering had been applied 1 inch thick; and, secondly, by filling the same pipe with steam, and, after closing all the valves, noting the time which elapsed before the pressure-gauge fell to zero. The first test resulted as follows (the amounts being given in cubic centimetres): Magnesia, plastic, 334; magnesia, sectional, 335; asbestos, fire felt, 367; asbestos, sponge moulded, 371·3; plaster of Paris and sawdust, 438; asbestos sponge cement, 604·5; the bare pipe, 1085. The second test confirmed these figures. The initial steam pressure was 30 lbs. It was pointed out by one member that these experiments agreed well with previous investigations, which had shown that the best coverings reduced the condensation to about one-third that in the bare pipe.

TECHNICAL RECORD.

SOUTHERN DISTRICT ASSOCIATION OF GAS ENGINEERS AND MANAGERS.

The Autumn Meeting of this Association was held last Thursday, at the Holborn Restaurant—the PRESIDENT (Mr. H. Smythe, of Maidstone) in the chair. The arrangements for the meeting, which included three papers of a practical and generally interesting character, attracted a large number of members.

The minutes of the last meeting having been taken as read, the members proceeded to elect the

OFFICE-BEARERS FOR THE ENSUING YEAR.

The PRESIDENT said he had to propose as his successor a gentleman whom they had known for a good many years, and who had had a large experience—namely, Mr. S. W. Durkin, the Engineer and Manager of the Southampton Gas-Works.

Mr. J. TYSOE (East Greenwich) had considerable pleasure in seconding the nomination of Mr. Durkin. The work he had already done would speak for him sufficiently; and he (Mr. Tysoe) was quite sure that in him they would have a gentleman who would fully sustain the traditions of the past.

The motion was unanimously carried.

Mr. DURKIN (who was at the time absent from the meeting) subsequently thanked the members for having put him in this place of honour. It was a position he had not coveted; but he certainly should treasure it as a great compliment on the part of his fellow members, and would do his best to maintain the dignity of the chair.

Mr. J. L. CHAPMAN (Harrow) proposed that Mr. Helps should continue his duties as Hon. Secretary and Treasurer. They were, he said, greatly indebted to Mr. Helps for what he had done in the past; and they could not do better than ask him to continue the good work.

Mr. C. GANDON (Lower Sydenham), who said he thought it would be quite a calamity to the Association if they lost Mr. Helps's services, seconded the motion, which was passed.

Mr. HELPS acknowledged the confidence of the members. He assured them that he would try to do the same for the Association in the future as he had done in the past; and if that had met with their approval, it was sufficient reward.

Mr. J. C. WATSON (Lower Sydenham) moved, and Mr. C. E. BOTLEY (Hastings) seconded, the election of Mr. W. Woodward, of Bromley, and Mr. F. Smallbone, of Hoddesdon, as members of the Committee; and this was agreed to.

Mr. W. D. CHILD (Romford) proposed that Messrs. W. H. H. Broadberry and C. E. Botley should be re-appointed Auditors; and, Mr. F. G. DEXTER (Winchester) having seconded the proposition, it was adopted.

NEW MEMBERS.

The following gentlemen were admitted as members of the Association, on the motion of the PRESIDENT, seconded by Mr. J. ELDRIDGE (Oxford): Mr. Levi Monk, of Lewes; Mr. H. H. Jones, of Margate; Mr. J. M. Veevers, of Rochester; Mr. T. E. Shadbolt, of Grays; Mr. J. W. Portass, of Bishop's Stortford, and Mr. D. T. Livesey, of East Grinstead.

Mr. FRANK LIVESEY (the Chief Engineer of the South Metropolitan Gas Company) then read the following "Notes on Coin Meters." He remarked that he had used the words "Coin Meters," because there were two or three different prepayment systems; and his notes only dealt with one of them.

NOTES ON COIN METERS.

There are probably between 80,000 and 100,000 houses and tenements in South London without any gas supply. Is it desirable to secure the inhabitants of these houses as consumers? and, if so, how is it to be done? Such questions have oftentimes been asked, but it is only lately that any solution has been found; and the prepayment meter, of the "penny-in-the-slot" description, is the discovery. Such consumers will, however, not be obtained by adhering to the obstructive conditions so common a few years past. The would-be consumer of this class will not buy fittings and pay for fixing them, nor will he give a deposit, for the simple reason, in many cases, that he does not possess it. A quarterly account, too, is quite out of the question; and it is unreasonable to expect him to pay for fixing the tubing in his landlord's house. If the gas company or corporation are to do their own share of the work as well as the tenant's and the landlord's portion, they cannot supply gas at the same price as to the ordinary consumer.

People are willing to pay for convenience, for it has its money value; and there can be no doubt that this system is a very great convenience. But, as well as being convenient, it is also as cheap as oil for lighting, and cheaper than any other system for cooking. Gas cooking will not compare favourably when the management of the stove is left to an extravagant cook; but it is quite a different matter where the housekeeper is herself the cook, and checks the expenditure by noting the pennies required, week by week, to cook the daily meals. The testimony of these consumers is that gas is the cheapest

method of cooking; and consequently, when it is supplied at 9d. per 1000 cubic feet cheaper to the ordinary consumer, there can be no doubt on the subject—always supposing it to be under proper management.

The quantity of gas consumed will vary with the habits of the people supplied. In country districts, it is comparatively low for lighting purposes. But, taking South London, as a whole the average will be about 11,500 cubic feet per annum; and where a cooker is supplied, another 8000 cubic feet may be added—making 19,500 cubic feet as a total. Taking the 11,500 cubic feet as giving the least favourable return, the question must be decided what amount is required for the hire and maintenance of the meter and fittings and for extra labour in fixing. The meter can be treated as in the case of an ordinary consumer—charging 10 per cent. on the net cost; and if this rate will pay for the meter, it will more than pay for the fittings, if they are of a substantial character, for they will not require so much attention, and should last as long before being repaired.

The accommodation given by the South Metropolitan Gas Company is: One pendant; two brackets, with burners and galleries, but no glasses; and one ring burner, or, in its place, a small cooker, having two burners on the hot-plate, with oven below. The cost is as follows:—

	£	s.	d.
The lighting portion	0	9	2
The ring burner	0	1	8
Labour for the above	1	1	0
The meter	2	3	0
The service, tap, and labour	0	12	1
	£4	6	11
If a cooker is substituted for the ring burner, add	1	4	10
Total	£5	11	9

The cost of connecting an ordinary 3-light consumer would be £1 18s. 1d.; so that there is an extra charge upon this class of £2 8s. 10d. when the ring burner is used. Now, 11,500 cubic feet of gas, at 3s. 1d. per 1000 feet, yields a rental of £1 15s. 5d. But the ordinary price of gas is 2s. 4d. = £1 6s. 10d.; thus giving 8s. 7d. per annum to pay all extra charges—that is, meter-rent, rent of fittings, increased cost of collection, and attention to the meters. The 8s. 7d. can be distributed as follows, though these are not exactly the figures adopted by the South Metropolitan Company:—

	s.	d.
Meter-rent	4	6
Fittings	3	6
Leaving for increased cost of collection and other charges	0	7
	8	7

Whether it is correct or wise to put the whole, or only part, of this expenditure to capital, must be decided by those most interested.

The question has arisen, if a cooker is supplied, whether a weekly rent should be charged. But surely this is not necessary; for, by adding roughly 30 per cent. to the cost, 70 per cent. is added to the revenue. Neither is such a plan satisfactory or convenient to the consumer.

The extra charges on this business are met by the increased charge for gas; leaving the rental received on the same basis as that of other small consumers. There is this advantage on the side of the prepayment meter, that the expenditure needed upon mains is much less. Taking the period since the starting of the system, every ordinary consumer has required an expenditure of more than twenty times the amount on new mains that was found sufficient for these new consumers. This is easily accounted for by the many miles of mains which are laid to supply street-lamps only. In one growing district of South-east London, 8180 yards of main were laid to supply 101 lamps and 171 consumers; but now the number of consumers has increased to 869—that is, 698 new services on the same mains.

In every gas undertaking, there will be a certain amount of bad debts, varying in different towns. In London the percentage on the rental appears to be higher than in most provincial towns; being about 0·58 per cent., as compared with 0·25 per cent. Though there are no bad debts, in the strict meaning of the term, with a prepayment meter there will be deficiencies caused in different ways—some by incorrect working of the prepayment movement, and a few probably by fraud. In the latter case, the simplest method seems to be to give the consumer the opportunity of making good the deficiency, or it may be damage done; and if no response is made, to at once remove the meter.

With some meters, the losses have amounted to 1¾ per cent. on the rental; but it must be remembered that the first ones issued were not so accurate as those now made—nearly all the makers having altered their first design for a stronger and simpler pattern. The 1¾ per cent. includes many of these early-pattern meters; and therefore it must not be considered as a permanent figure. There is, in fact, no reason to suppose that the losses on the prepayment system should be greater than the bad debts of the ordinary consumer.

For this purpose, the prepayment mechanism should be strong, as, at times, the meter receives rough treatment. The arrangement for regulating the price should allow of alterations of one cubic foot of gas (or even, in some cases, half a cubic foot would be necessary), with facilities for making the alteration quickly, and without moving the meter. When the purchased gas is all exhausted, the supply should be shut off by means of a valve, giving warning shortly before the gas is consumed. When the coins are deficient as compared with the index, either the meter is out of order, or there is some fraud taking place, which in a few cases it is difficult to detect. But most of the first clumsy attempts in this direction are so clearly brought home to the consumer when the money-box is opened, that they have not been tried a second time; and the methods now adopted in the best meters will prevent tampering in cases where this evidence is not forthcoming. The prepayment mechanism appears to be more conveniently placed at the side than at the top of the meter; for it is at times difficult to find a good position for the meter in small houses, and it is more so if the height is increased some 4 or 5 inches.

For the financial success of this system, it is very necessary to know what the average consumption will be—information which can only be gained by trial. Having found this to be satisfactory, it is only necessary to add a sufficient amount to pay the extra capital and revenue charges; and the success will be certain. It has also this recommendation—that the consumption more nearly approaches a regular winter and summer demand than in the ordinary course. It is a more satisfactory business to the manager than, for instance, gas-fires, which are only required at the darkest time of the year, during the coldest weather, and when all the manufacturing apparatus is strained to the utmost.

[At the conclusion of the paper, Mr. Livesey said that with regard to the item in the first table "Leaving for increased cost of collection and other charges, 7d.," he was bound to say that the 7d. did not cover that increased cost. They had had a little experience in collecting these amounts; and he could not help saying that it was a heavy item. It cost considerably more than the ordinary collection; but as the different districts filled up, they had great hopes that the figures would be much reduced. Certainly the 7d. would not pay the "other charges."]

Discussion

The PRESIDENT remarked that Mr. Livesey had brought forward a subject which was of great and growing interest. Notes of this character were, in his opinion, as good as a paper for the purpose of raising a discussion; and he hoped they would lead to a good one.

Mr. A. DOUGALL (Tunbridge Wells) said that during the present year he had had some considerable experience in the application of the coin system; and he might say that at first it was thought by some of their people that the system would do very well in manufacturing towns, but that it was not at all applicable to residential towns such as Tunbridge Wells. However, they finally decided to give the system a trial; and they resolved to fit up houses of a rental of £20 and under per annum, laying the service free, fixing the meter, and running the supply to four different parts of the house. They furnished, free of charge, a pendant, two brackets, and a boiling-ring; but in some cases they supplied a cooker, for which they charged a rental of 2s. 6d. The total cost in their case of doing this work was something like £4. The present price of gas to the ordinary consumer was 3s. 3d., and to the prepayment consumers they gave 20 cubic feet for 1d., which made the price 4s. 2d. per 1000 cubic feet. They had not had the system in operation the whole year through; so he could not give exact figures with regard to the consumption per house. But from the figures that had been placed before him, he could see that the average consumption of gas would at all events exceed 10,000 cubic feet per annum. Well 10,000 cubic feet at 11d. gave them a profit of about 11 per cent. on the total outlay. About three years ago, he had occasion to prepare some figures regarding the gas supply of the district; and he found that of 5300 inhabited houses, only 2325 consumed gas—2975 using oil or other illuminants. He also discovered there were 120,000 gallons of oil being consumed in the town. These figures were quite conclusive to his mind that there was ample scope in the town for the introduction of such a system as Mr. Livesey had described; and their experience since had fully confirmed that. They only started the system at the beginning of the year, and had already fitted up above 1000 houses; and they had yet a great many orders to execute—in fact, he believed that, before they had finished, they would reach 2000 consumers. The people who had had—he was going to say—the privilege of having a supply of gas on this system, very highly appreciated it; and the Company had not had a single meter returned. Everyone who used it spoke in glowing terms of the meter, and would not now like to be without it. They all understood the trouble of cleaning and trimming lamps, and the annoyance, to say nothing of the cost of the glass chimneys which were broken—it must be something considerable. The oil merchants and small coal vendors were all feeling the pinch caused by the introduction of the prepayment gas system; and he only heard the other day that the sweep was complaining that his occupation would very soon be gone—gas as a fuel having obtained such a hold, that sweeps would very soon have to look out for some fresh employment. (Laughter.) The prepayment system would mark an epoch in the history of gas companies, and a very important epoch. It would be a source of profit to the companies, and a great boon to all who took advantage of it.

Mr. GEORGE LIVESEY asked Mr. Dougall if he would kindly state on what grounds he justified the charge of 2s. 6d. for the

stove, seeing that he obtained an extra 11d. per 1000 cubic feet for the gas burnt.

Mr. DOUGALL replied that they could only justify it on this ground—that in the one case they expended £4, and in the other £6 odd, on each house; so that they charged about 5 per cent. on the cost of the stove.

Mr. LIVESEY: Does not the 11d. cover it?

Mr. DOUGALL: More than cover it. (Laughter.)

Mr. W. H. H. BROADBERRY (Tottenham) said that about a year ago his Company determined to try the prepayment meter system. They got fairly into work at Christmas last; and up to the present, they had fixed something like 1000 meters. Mr. Livesey's estimate of the first cost was something below theirs; the total expense being, he believed, about £4 19s., as against the £4 6s. 11d. quoted by Mr. Livesey. So far, they had no cause to complain. Of course, there had been a few hitches, or a few little irregularities in the registration of the meters; but considering the number of meters that had gone out, he thought the complaints they had received had been remarkably small. Certainly, he believed all the new consumers were perfectly satisfied with the system. As to the charge, they simply added an extra 6d. per 1000 cubic feet; and they calculated that each house would have to burn 18,500 cubic feet of gas to pay the interest on the outlay. The system had not, as he had said, been in operation a twelvemonth yet; but he should say that, judging by the past, it would be a decided success from the Company's point of view. At the present time, they had something like 250 applications for these meters in the office; and really the difficulty seemed to be to lay the services and get fitters to do the work fast enough. On the question of the cost of collection, in all these new systems, it rather puzzled one to know exactly what it did cost—the inspection and collection were bound up together; and if they took the cost of the inspection of a thousand additional meters in the year, it would amount to a considerable sum, independent of the collection. In his case the inspection and collection ran together. Since they commenced the system, only one consumer had discontinued his supply; and that was because his house was condemned, and had to be pulled down. (Laughter.) With regard to gas-cookers, he might say that some years ago, his Company commenced lending them out on hire; and they had some returned partly worn out. They hardly knew what to do with these; and it occurred to them that they would allow those of their prepayment customers who they thought would be likely to use a stove to have one of these old ones in place of the usual boiling-ring. In this way, they had nearly cleared off the whole of the old stock. Mr. Livesey had stated that he supplied three burners, but in their case they gave four; and this accounted to a certain extent for the little difference in cost—£4 19s., as compared with Mr. Livesey's £4 6s. 11d. He hoped that, in his reply, Mr. Livesey would touch on another subject which he had not mentioned in his paper—that was, the meter makers' guarantee. Mr. Livesey pointed out—he thought quite correctly—that the first prepayment meters made were not anything so perfect or so strong as were those now manufactured. After the meter makers had got some thousands of these meters out, they very quietly informed gas companies that they were going to reduce the guarantee from five years to one. There was no doubt that some of the meters had been out eight or nine months before the notice was given. He did think that they, as representatives of gas companies, should have some discussion upon, and voice in, this matter; for it seemed to him that by making an extra charge for these meters, and then reducing the guarantee, the plums were all working into the meter makers' hands. The meter makers formed rings; and he saw no reason why the gas companies should not also do so. He certainly thought the Association should call a meeting, at which they might fairly discuss this question; and he believed that one thing would come out of it which he should be very pleased to see, and that was a Co-operative Meter Association in connection with Gas Companies.

The PRESIDENT remarked that he did not see that the question of the guarantee of meters came within the scope of Mr. Livesey's paper; and so he would suggest that members should not discuss it on the present occasion.

Mr. C. E. BOTLEY (Hastings) said he had not had a very long experience with prepayment meters; but so far as it did go, it was satisfactory. He waited for some considerable time before starting, thinking, the same as Mr. Dougall, that a place like Hastings was not altogether suited for the development of the system. But he was induced to go in for it by the fact that he saw a good many people giving up gas, owing to the cheapness of oil. In his case, they simply supplied the prepayment meter, and had not done any fitting. They added 5d. to the charge per 1000 cubic feet of gas for the rent of the meter and the cost of collection. The system had been in use only a short time; but still they had from 200 to 250 meters fixed. He could not yet say how it would work out; but if the price charged was too high, they would endeavour to bring it down to what was fair and reasonable. They were also supplying, where required, a small stove, for which they charged a further 5d. per 1000 cubic feet—making for the meter and stove 10d. extra on the price of the gas. The cost of collection was a considerable item; but it might be lighter when the system developed. Up to the present, they had only had one or two cases of failure with these meters; and they now made the customers sign an agreement to the effect that they would be responsible for the consumption of gas as registered by the meters. This, he thought, would put an end to one or two bothers they had had; but, generally speaking, the system had been satisfactory.

Mr. F. G. DEXTER (Winchester) inquired as to what was the method adopted to make known the prepayment meter system in a town when it was first introduced. Was it done by circular or otherwise? They knew that difficulties had occurred with existing consumers as to whether the extra price put upon the gas was an adequate sum, or too much, for the value of the meter or the fittings supplied. He had had one or two cases in which the consumers thought they were paying more for the meters and fittings than they should legitimately do, because the larger the consumption of gas, the greater the rental they paid for the fittings.

Mr. J. T. JOLLIFFE (Ipswich) asked Mr. Livesey if he would give the members some information as to his system of collection. In his own case, he collected monthly; and he was trying to work up a system whereby the collectors should be put on piecework, and be paid so much for each collection. He should also like to ask as to the disposal of the coppers collected, because he had found great difficulty in that direction. Last month, he had £120; and the month before £210. He took the coppers to the bank; and they simply laughed at him. He then went to the pawnbrokers; and they, for the consideration of 3d. in the pound, agreed to relieve the Company of their burden. (Laughter.) It might perhaps interest the members to know that the first cost in his case was somewhat under £4 per house. They supplied four governor burners, as they thought that by this means undue waste was checked, and also that it would prevent the prejudice that might possibly arise from extravagance in the use of the burners. They also supplied a boiling-ring, but charged a rental for the gas-stoves. He thought they were quite justified in doing this, because, although the consumption of gas per house when a stove was in use was considerably more than in those cases where there was not one, he found, as a matter of fact, that the interest obtained upon the outlay was less than the interest on the outlay with the burners alone. This might not be the case with all gas managers; but it was so with him. They merely charged an additional 6d. per 1000 feet of gas. This was hardly enough; but having adopted it, he did not think it wise to alter it.

Mr. J. W. HELPS (Croydon) said he should like to make a few remarks on this subject, though, when he noticed Mr. Livesey's paper bore the title "Notes on Coin Meters," he felt he was somewhat "put out of court," inasmuch as the discussion on the paper would naturally take one line—that was, on penny-in-the-slot meters only. He (Mr. Helps) had had a considerable amount of experience with the system of prepayment and the fitting up of houses on a rental, during the last five years. They started at Croydon in the Christmas quarter of 1889; and they had gone on increasing slowly, but surely, up to the present day. They had not from the very beginning attempted to push the system to any great extent; but they had let it grow by itself. That was a point upon which he did not want to say much, because he did not wish to lay himself open to such severe criticisms as he did by a few remarks he made a short time ago. However, he might say that he still held the views he then expressed.* The total number of consumers in Croydon was about 7500; and of these something over 1000 were on the prepayment system. Of these about 800 had been supplied with fittings; the others were simply those customers who, previously not using gas, or perhaps, having been in the habit of paying a deposit to which they objected, were led to wish for a prepayment meter in substitution of the ordinary one, which was a very rare occurrence. Now the total cost per consumer of fitting up houses with the meters in his case was somewhat higher than the figures that had been mentioned during the discussion, inasmuch as it reached to the other side of £5. This was caused, first of all, by giving rather more than Mr. Livesey—a couple of extra burners; and secondly, after one or two years' experience, he found that the rather cheap fittings they were in the habit of using caused at times considerable trouble through escapes and breakages. They now consequently paid a little more for the fittings than most of the gentlemen did who had already spoken. That morning he had the curiosity to get out a few figures with regard to what they were actually doing at Croydon at present from a pecuniary point of view. He found that for the year ending Dec. 30 last, the prepayment consumers had burnt nearly 16 million cubic feet of gas—that was, out of a total consumption of about 480 millions—and the amount of money taken during that period was something like £2700. Now, of course, the cost of collection had to be taken into account. This was a point that was generally brought up as an argument against the system he had adopted—that was, instead of having a penny-in-the-slot meter, he had a system which necessitated a man going round, and putting on the quantity of gas that was wanted by the consumer. Some gas managers argued that this was a costly system; but Mr. Livesey had mentioned in his paper that the cost of collection in his case was something like 7d. per 1000 cubic feet. He (Mr. Helps) was not a very rapid arithmetician; but while Mr. Livesey had been reading the paper, he had been making a rough calculation of the cost in his

* See JOURNAL for Sept. 18 last, p. 559.

own case. They had two men who were paid something like £75 or £80 a year. Those two men had been quite sufficient to do all that was necessary in collecting the money and putting on the gas for the 1000 consumers; and he did not think this worked out to more than 3d. per 1000 cubic feet.

Mr. LIVESEY: The 7d. I mentioned is per consumer burning 11,500 cubic feet.

Mr. HELPS (continuing) said he thought in his case it was a trifle under 3d. per 1000 cubic feet. They did not charge anything extra on the price of gas; but that was a matter which could be argued for and against both from a practical and a sentimental point of view. To him it did not seem fair that the large consumer should pay more for his meter and fittings than the small one; and he did not think that a meter and fittings were worn out any quicker by burning 10 cubic feet of gas per hour than by burning only 5 cubic feet. They found in their case that among these consumers were a great many who wanted to get hold of gas-cookers; and there were 250 of the prepayment consumers who had had stoves of varying sizes fitted up. Like Mr. Dougall and others, they found it necessary to charge a rental for these stoves, in addition to anything they might charge in the ordinary way. Mr. Dexter had asked a question as to how notice was given in the district of the intention of a company to start such a system as this. At Croydon, they commenced in a small way. They simply took out of the centre of the town certain streets, in which were what would come under the designation of artizans' houses, of about £30 rental—rents being rather heavy in Croydon. They simply sent round, by their own officials, a description of what the Company intended to do, and telling the tenants that they were prepared to fit up their houses and supply them with gas on this system. When these houses were practically exhausted, they commenced to supply the meters within a radius of 2 miles of the offices. One of the disadvantages of the system which he advocated was that it would not do to have one of the meters at one end of the town and one at the other; and this was one of the reasons why they were going so slowly. They found, after carefully working it out, that the average amount of gas used per consumer was about 18,000 cubic feet, and that the profit, leaving out of the question the interest on the capital (which was covered by the rental of 2d. per week which was charged), was about 16s. 8d. from each customer, while the 2d. brought in about 8 or 9 per cent. on the total cost, including meter, &c.

The PRESIDENT remarked that he had had a little experience with this system of gas supply. He regarded it as one that had developed in a way that no one dreamed of when the first meters were brought out; and it was likely to develop to a greater extent in the future. His Company, when they took it up something like a year ago, went to work in a cautious way. They did not "push" the system by any means. They selected a district of the town, and selected the customers as well; and they took care to charge a good amount for interest on the outlay—to the extent of 1s. for each 1000 cubic feet of gas consumed. His experience soon showed him that there was a great demand for cooking-stoves in connection with the system. Up to that point, the consumers were only consuming gas at the rate of about 1000 cubic feet per month; but after cooking-stoves were fixed, the consumption rose to 2000 feet per month. As he had said, they charged 1s. extra for the hire of the fittings, which perhaps was rather excessive. But, like others, he found the cost of collection was somewhat heavy; and he had the comfort of knowing they had the collection, as well as the other charges, well covered.

Mr. LIVESEY, in replying upon the discussion, said that the remarks which had been made by Mr. Dougall and Mr. Broadberry were more in sympathy with, than criticisms upon, the paper; so he had nothing to say in answer to them. Mr. Jolliffe asked how often the boxes of the meters were emptied. They thought well to empty theirs each month, though they were not always cleared so quickly as that—sometimes they went six weeks. The collectors were taken from the class of working men; and they did their work very well at present. They were doing about 770 accounts per month each; and, multiplying that by twelve, would give the number of accounts they did in the year. They had thought of introducing a kind of bonus system, because when these meters were first fixed, there would perhaps be only two or three in one street, then the collector would have to walk a quarter of a mile to get to half-a-dozen in another street. The circumstances were altogether different now. The meters were being largely fixed in all the districts, and so the work was being brought closely together. They thought that, as the cost of collection was very heavy, the men could now do more than formerly. The chief rental clerk believed they might get up to 1000 per month. The point referred to by Mr. Jolliffe, as to the disposal of the coppers, was a difficult matter; but, in their case, they had made terms with the London and South-Western Bank, but he did not think he was at liberty to say what those terms were. They were collecting about £900 in coppers per month; and these were put up in 5s. lots, in little blue bags, and sent to the bank. Exceedingly few of the prepayment consumers had discontinued to use gas; and the Company were perfectly satisfied with the rate of increase. They found that the fittings ordinarily supplied for this class of work were not good enough; and so they now had them made to their own patterns. They were better in all respects, and were very good and strong. With regard to Mr. Botley's remarks, they ought to have it clear about the extra charge of 5d. or 10d. in his case. Did Mr. Botley charge an additional 5d. with only lighting and ring burners, and 10d. extra if they gave the consumers a stove?

Mr. BOTLEY: The 10d. includes everything.

Mr. LIVESEY: That means 10d. extra on all the gas consumed?

Mr. BOTLEY: Yes.

Mr. LIVESEY (continuing) said that, with reference to making the system known, when once they had the meters scattered about the district, it was not necessary to work it any further. In their case, they had at first a system of giving a bonus to their workmen for every new consumer; but, finding that this brought in the consumers a great deal faster than they could supply or fix the meters, they had discontinued it. If, however, the numbers dropped off, in spite of what Mr. Helps said, they should go on with it.

Mr. F. G. DEXTER, of Winchester, next read a paper entitled "Outdoor Lighting by the Incandescent Burner." In the discussion that followed (a report of which will appear, along with the paper, next week) Messrs. J. L. Chapman, T. May, jun., Frank Livesey, S. W. Durkin, A. E. Broadberry, J. W. Helps, and the President took part.

Mr. S. W. DURKIN of Southampton, followed with a brief communication headed, "How an Electric Current introduced Gas into an Electric Culvert." There was no discussion on this paper.

Before the close of the business of the meeting,

Mr. C. C. CARPENTER (Vauxhall) proposed a hearty vote of thanks to the readers of the papers. The two natural enemies of gas undertakings were the electric light on the one hand and oil on the other; and they had had, he said, two very good instances, on both sides of the question, how they could best meet their advances.

Mr. C. S. ELLERY (Bath) seconded the proposition, which was unanimously passed.

This concluded the business on the *agenda;* and the members afterwards took tea together.

Institution of Civil Engineers.—The opening meeting of the Institution for the present session will take place this evening, when the President (Sir R. Rawlinson, K.C.B.) will deliver his Inaugural Address, at the close of which the medals and premiums awarded last session will be presented.

Increased Use of Water-Meters in the United States.—In the course of a recent letter to one of the New York papers on the use of water-meters, Mr. J. Thomson stated that about six years ago the yearly output of these appliances by all the makers in the United States probably did not exceed from 12,000 to 15,000; whereas last year from 30,000 to 35,000 were made and sold. During the same period, as the consequence of increased demand and competition, the price had been reduced about 25 per cent.; and, concurrently with this, their general efficiency and durability had been greatly improved.

The Petroleum Trade of Philadelphia.—According to a recent Philadelphia journal, the condition of the export petroleum trade is highly satisfactory. At the time the newspaper report was written, there was in the port the largest fleet of oil-vessels ever seen there at one time; and at least 15,000,000 gallons of crude and refined petroleum were required so as to supply the orders on hand for this particular class of vessels. The average cargo of a modern tank-ship is 1,500,000 gallons. The shipments from Philadelphia in one week lately amounted to 5,075,000 gallons; and it is believed that the year's exports will be the largest ever known.

Formation of an Association of Yorkshire Students of the Institution of Civil Engineers.—An Association of Yorkshire students of the Institution of Civil Engineers has lately been formed in Leeds, as the result of a project initiated by Mr. W. Spinks, Assoc.M.Inst.C.E. It has the support of a number of influential local gentlemen, among them being Sir James Kitson, Bart., M.P., and the Leeds City Engineer (Mr. T. Hewson); the former being the President, and Mr. E. B. Martin, one of the officials in the office of the latter, the Secretary. The inaugural dinner took place on the 3rd inst. in the Queen's Hotel, Leeds—the President in the chair; and, although the gathering was small, it was very successful. The new Association seems to have useful and practical work before it.

Compressed Gas for Locomotive Head-Lights.—For the lighting of the head-lamps on locomotives, compressed gas has been used for some years in South America; and it is being applied on 25 suburban engines now being constructed for the Central Railway of Brazil. The Pintsch system is the one adopted. The new engines have gas-lamps in two 20-inch head-lights, four signal-lights, and a gauge-light in the cab. The gas-tank is below the floor of the cab; and the lights at either end can be turned down according to the direction in which the engine is running. In tests recently made on an engine in the Hoboken yards of the Delaware, Lackawanna, and Western Railroad, says an American contemporary, it was found that, while the light was much more powerful than the oil-lamp commonly used, it did not interfere with the reading of the signals, as the electric head-light is said to do.

MIDLAND ASSOCIATION OF GAS MANAGERS.

We conclude to-day our report of the proceedings at the recent meeting of the above Association at Birmingham, by giving the paper read by Mr. J. T. Lewis, of Wellingborough, with the remarks made thereon.

THE USE OF CHARGING AND DRAWING MACHINERY IN SMALL AND MEDIUM-SIZED GAS-WORKS.

In bringing this subject before your notice to-day, it is not my intention to inflict upon you a lot of detail, but rather to put before you as briefly as possible the salient points of the system. When I promised this paper to our energetic Secretary, I was induced to do so in the belief that the subject was one of such general interest that a free discussion was bound to ensue, whatever might be the merits of the paper itself.

The use of charging and drawing machinery is of comparatively recent date; the first manual machines being put into work at Maidstone in 1875. Since that time, the use of machinery has gradually extended; but in so slow a manner that it appears as if the advantages of the system, financial and otherwise, are not so well known as they should be. That the use of manual machinery has many advantages over manual labour only, I hope to prove to you to-day. I was deeply interested in the valuable discussions that took place after the reading of papers on kindred subjects at the May meeting of the Institution of Gas Engineers. I was also surprised to hear some of the statements made during the discussions; one gentleman, for instance, going so far as to say that "machinery was almost as expensive as hand labour, unless one had to make 2 million cubic feet of gas per day or more, and it was not all works which wanted to produce as much as this. *For smaller works it would not do.*" During the past few years, I have visited works, and made many inquiries where machinery is in use; and this, with the practical experience gained by the working of the machinery under my own observation, leads me to say that the actual facts are quite at variance with such statements as are contained in the foregoing extract.

I find one of the chief hindrances to the extension of the use of machine stoking is the want of height or width, or both, in the existing retort-houses. Where such difficulties exist, the desire to adopt machinery can only be accomplished when the old houses are rebuilt or new ones erected. There must, however, be other reasons than the want of space, when we find new houses erected and machinery not adopted. Such a state of things seems to indicate considerable doubt, either upon the efficiency of the machinery, or the economy to be effected by its working; or it may be possible that some are frightened at the rather large capital expenditure necessary to instal the machinery.

As the title of this paper will lead you to expect, I intend to confine myself strictly to the use of machinery in small and medium-sized works; feeling assured that, if it can be proved that machinery is successfully and economically in use in works of small size, it must also be in a greater degree successful in large works. To more clearly define what I mean by small and medium-sized works, I may say they are those in which the annual make of gas is not less than 20 nor more than 200 million cubic feet; in other words, where the maximum daily make is not less than 100,000, nor more than a million cubic feet. There are at the present time in the United Kingdom about 320 works that come under this definition; and out of these, only 13 have adopted the system of machine stoking. In works producing more than 200 millions, manual machinery has, of course, been adopted to a much larger extent. In speaking of manual machinery, let it be clearly understood that I refer to West's; for although there may be other manual machines, West's are the only ones that, as far as I am aware, are working successfully.

It is unnecessary here to give a detailed account of the machinery. Briefly, it consists of the following apparatus: A coal-breaker of special and strong design, driven by a specially constructed vertical steam-engine of from 6 to 10 nominal horse power, according to the kind of coal to be broken; a coal-elevator, which gathers up the coal as it falls from the breaker, and delivers it into the store-hopper, which is fixed at such a height and in such a position as enables the charging-machine hopper to be brought under for supplies; a charging-machine fitted with adjustable coal-hopper to hold about 36 cwt. of coal, and a charger fitted with propelling and hoisting gear; a drawing-machine, complete with rake and hoisting gear; and platforms, one each for the charging and drawing machines. Rails are laid on the floor to enable the two machines to be moved with ease to any point in front of the stack. The whole of the machinery is strong and of simple construction; and any man of ordinary intelligence finds no difficulty in mastering the necessary details for its proper working. The cost of the complete set of machinery will be between £800 and £900, according to the position of the works and the kind of coal-breaker required for the coal used.

The above cost of the machinery is, I consider, the whole additional charge incurred in installing manual retort stoking machines. Such additions as the stage-floor are not absolutely necessary for machinery. As, however, most modern houses are constructed with the view of economical working, this involves the use of either generator or regenerator furnaces; and when these are employed, the stage-floor possesses undoubted advantages, even over very roomy vaults. Any additional height or width in the building itself is fully covered by the advantages derived therefrom.

Interest at the rate of 5 per cent. per annum on the total cost of the machinery should be charged in the cost of working. Wear and tear—including the engine, coal-breaker, and elevator—does not appear to be any more than under the old system of manual labour, for rakes, shovels, and barrows. This item is included in the expenses, and is the actual cost taken over a series of years and the average struck. Allowance should be made for oil, waste, &c., which, however, is only a slight fraction of a penny per ton of coal carbonized. To those who wish to know exactly what this wear and tear on the machines will cost them at the outside, I understand from Mr. West that his Company are prepared to enter into agreements to keep the machinery in thorough going order for 4 per cent. per annum on the total outlay.

TABLE *showing Working Results with West's Manual Machinery.*

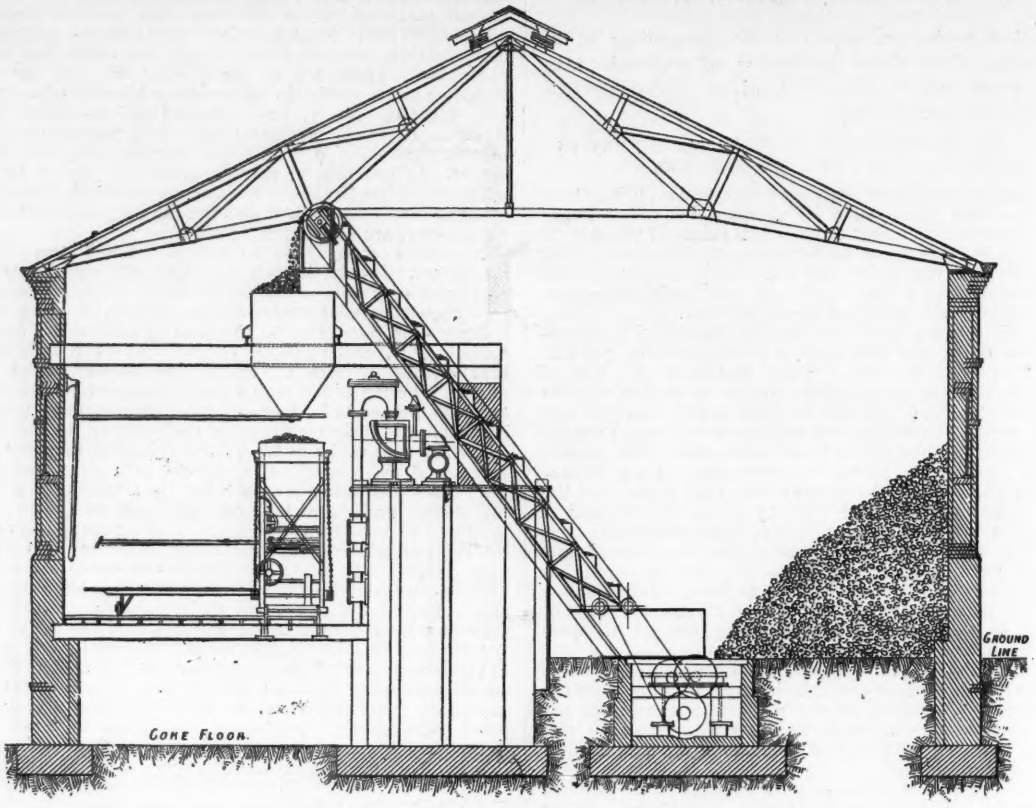
No. of Works.	Tons of Coal Carbonized per Annum.	Gas Made per Annum.	Average Wages per Ton.	Interest, Wear and Tear, Oil, Waste, &c.	Total Cost per Ton.	Estimated Cost by Hand Labour.	Saving by Machinery.	Remarks.
			s. d.	d.	s. d.	s. d.	s. d.	
1.	7,830	83,000,000	1 11·25	2·00	2 1·25	3 8·0	1 6·75	Wages include all labour in the retort-house; also attention to boilers and exhausters.
2.	2,080	21,519,000	2 0·09	5·36	2 5·45	3 6·0	1 0·55	Do., from emptying the coal-waggons to throwing up the coke, and attending to the boiler, exhausters, and pumps.
3.	21,436	225,000,000	..	..	2 0·00	2 8·5	0 8·50	Do., from emptying the coal-waggons to wheeling out the coke.
4.	..	..	..	..	1 2·00	2 0·0	0 10·00	As the machinery has not been working a complete year, further particulars are not given.
5.	17,277	188,413,000	1 5·75	1·84	1 7·59	2 9·0	1 1·41	Includes stokers, coal and coke wheelers, and firemen.
6.	..	..	1 3·44	..	..	..	..	The figures give cost of working in No. 1 house, where manual machinery is entirely used.*
7.	..	160,000,000	1 6·97	1·89	1 8·86	2 9·0	1 0·14	Wages include machine men, lid openers and closers, pipe jumping, coke wheelers and quenchers, and firemen.
8.	..	130,000,000	1 6·40	1·99	1 8·39	3 0·0	1 3·61	
9.	..	160,000,000	1 8·19	1·70	1 9·89	3 0·0	1 2·11	
10.	..	16,000,000	2 1·00	3·00	2 4·00	3 6·0	1 2·00	Wages include all work for retort-house, boiler, engine, and exhauster, and sulphate works; also wheeling and quenching coke.

Note.—The figures in regard to the last four works (Nos. 7 to 10) are extracted from a paper read by Mr. John West at the meeting of the North British Association of Gas Managers in Edinburgh, July 23, 1891.

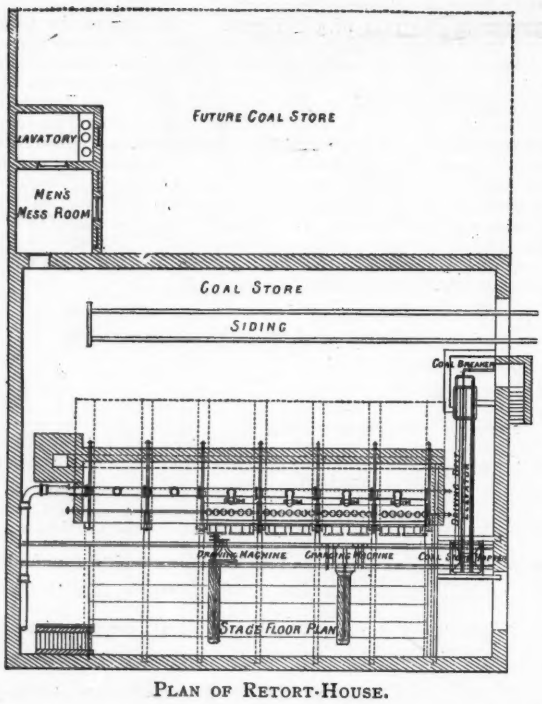
* In this house there are twelve through beds of eight retorts, equal to 96 mouthpieces, on each side, or a total of 192 mouthpieces. The two sets of machines draw and charge the 192 retorts five times in the 24 hours, with 2·85 cwt. in a charge, equal to 14¼ cwt. per mouthpiece per day, or 11·8 tons per through bench in the 24 hours; being 136 tons 16 cwt. per day. Wages include machine men, luting men, coal and coke wheelers, engine men for the coal-breaker, and furnace attendants. Including the foreman, the wages would be 1s. 4·66d. per ton.

From the accompanying table, showing the actual results obtained at various works, it is clearly proved that the average saving effected is upwards of 1s. per ton of coal carbonized. This alone should be sufficient, where it is possible to do so, to induce managers to adopt the machinery. Yet this is not by any means the only advantage derived from its use. First and foremost among the advantages other than pounds, shillings, and pence, is the reduction of the most arduous work of the stoker. I am satisfied that, whatever may be our views in other respects, we are at one in desiring to make the lot of our

WEST'S MACHINERY AT THE RUSHDEN AND HIGHAM FERRERS GAS-WORKS.



TRANSVERSE SECTION OF RETORT-HOUSE.



PLAN OF RETORT-HOUSE.

workmen better and brighter. In this respect, all who have any experience of machine stoking are unanimous in agreeing that it does to a very considerable degree lessen the toil and exposure of the men.

The saving of time in both drawing and charging is an important consideration. All of you who had the opportunity of seeing the drawing and charging by means of these machines at the works of our esteemed President last May will agree that the operations are performed in a remarkably short time. All users of the machines are unanimous on this point; the only question being as to the actual time taken. Mr. S. Glover, of St. Helens, says he has tried the time of his men, and found that, from the time of starting the charge to the finish and the closing of the lids, it was less than half a minute per retort per charge. I have no doubt that others can say the same; and it may certainly be taken that the whole operation of drawing and charging can be performed in less time than it takes to draw a retort which has been charged by hand.

The make of gas is increased per ton and per mouthpiece, through the more expeditious working and the even distribution of the charge—in fact, it appears almost impossible for the retorts to be badly charged. The charge can be varied as may be necessary to suit a setting or retort that is either above or below the normal state of heating. The retorts recommended by Mr. West, and those which are generally found to be most suitable, are 22 in. by 16 in. ⌂'s. At the recent meeting of the Eastern Counties Association, during the discussion on Mr. Child's paper it was suggested that retorts of less height would be better; but any alteration in this respect would be a retrograde one. There must be ample room between the retort roof and the charge to be withdrawn to allow of easy and expeditious working.

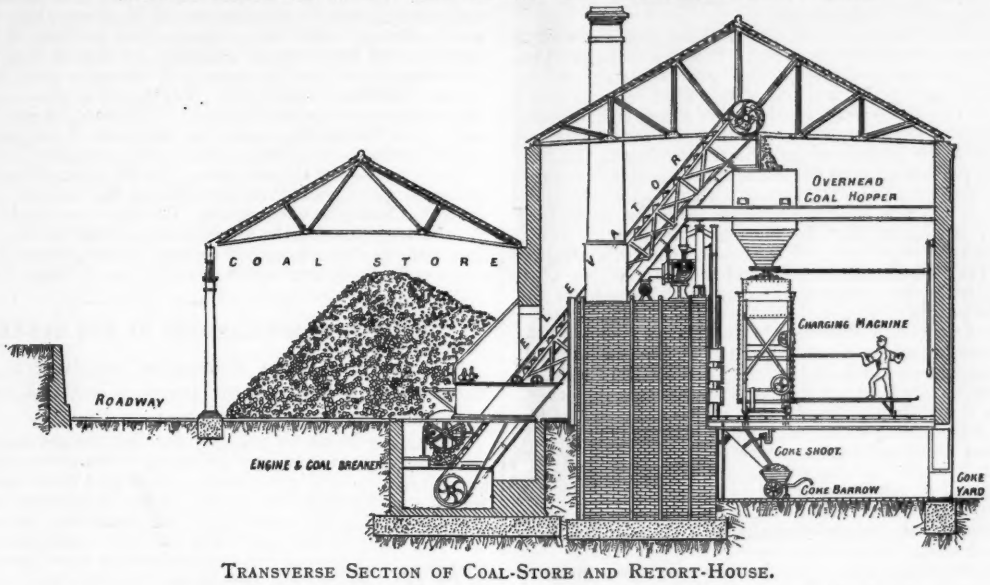
Settings of any number of retorts or tiers can be dealt with; but, for small works, settings of six retorts in three tiers are probably the best. Whatever may be the number of retorts in a setting, the tiers must be of the same height throughout the house. The mouthpieces should be of the same section as the retort, and slightly larger, so as to prevent any choking up of the mouthpiece when the charge is withdrawn. The mouthpiece lids must not project more than 2 ft. 5 in. from the face of the retort-stack; the distance from the face of the stack to the machines being 2 ft. 6 in. They must be arranged to close back, and be hinged so that they close in the same direction as the machines travel in working.

The size of the house is the most important matter; for, as previously stated, it is the absence of sufficient width and height that prevents, in many cases, the adoption of machinery. To work comfortably, the width from the face of the retort-stack to the retort-house wall should not be less than 22 feet, the height from the charging-floor to the under side of the roof principal foot-plate, not less than 24 feet. Even with this height, care must be exercised to see that the position of the coal-store hopper is between the principals, and not under them, as has sometimes happened.

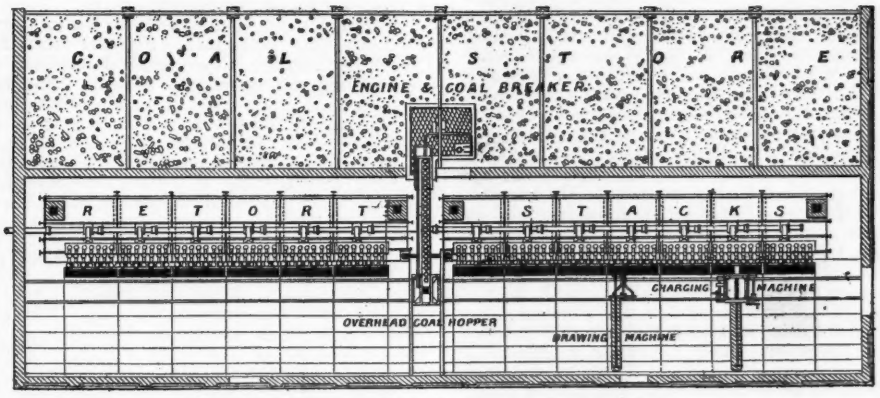
The position of the coal-store is an important matter; but whether it is under the retort-house roof or not is of little consequence, so long as it is within easy distance. The best position for a single-house coal-store is on one side of the house, so that the coal can be broken and elevated directly into the store hopper. There is no difficulty in dealing with the coal if the store is some distance away; yet the additional cost for extra power and conveying machinery adds considerably to the capital outlay.

Where it has been impossible to put in a complete set of stoking machinery, the drawing-machine has been in many cases adopted, and with satisfactory results; but as the machine has generally been adopted at the time when other important alterations have been made, it is impossible to give in actual figures the saving effected by its use. Several of our members

WEST'S MACHINERY AT THE COLNE AND MARSDEN GAS-WORKS.



TRANSVERSE SECTION OF COAL-STORE AND RETORT-HOUSE.



GENERAL PLAN OF COAL-STORE AND RETORT-HOUSE.

have the machine in operation, and doubtless they will be able to say what the advantages are. I will only quote the words of one of our Past-Presidents—Mr. B. W. Smith—who says:

The only machinery we have in connection with the retort-house is West's hand drawer; and it would be rather difficult for me to give any absolute figures as to the saving effected by its introduction, seeing that at the time it was introduced I made a thorough rearrangement of the retort-house work, so as to meet the requirements of the five-hour charges of the regenerator settings, which I started at the same time as the introduction of the machine to the house. I can safely say this, that there is no question as to the wisdom of introducing them to any works. They must save enormous wear and tear to the retort and rake; and this cannot be done without the saving of labour to the men, who were in the first place much against their use, and are now as much in favour as they were against.

In closing, I beg to call your attention to the plans of two small houses erected within the last four years, and arranged for manual machinery. Mr. H. Simmonds, of Colne, Lancs., has very kindly lent me the plans of his retort-house, and given the following description:—

The retort-house is a single house of the stage-floor type. It is 153 ft. 6 in. long by 38 ft. 4 in. wide inside the walls. The space between the retort-stacks and the retort-house walls is 22 feet. The retort-stacks are 11 feet wide; leaving a space at the back of 5 ft. 4 in. The height from the coke-floor to the stage-floor is 8 feet; and from the stage-floor to the roof principal, 26 ft. 5 in. The two retort-stacks are each 67 ft. 6 in. long by 11 feet wide; a space of 7 feet being left between the two stacks for the coal-elevator. The coal-shed is at the back of the retort-house, and is 153 ft. 6 in. long by 30 feet wide. The coal-breaker and engine are fixed in the centre of the coal-store, where the carts discharge direct into the same. The coal is raised into the fixed store hopper by means of the elevator, passing between the two retort-benches. Each bench of retorts consists of six settings of eight retorts, 22 in. by 16 in. Ω's, 10 feet long, heated by regenerator furnaces. Each setting has a separate hydraulic main fitted with West's improved tar and liquor valves; and anti-dips are used of my own design. The coke is drawn from the retorts into the coke-shoot, which runs on rails the whole length of the house, and discharged either into coke-barrows, or direct on to the floor of the coke-vault. Last winter, from November to the middle of February, when we had nine beds, or 72 retorts, in work, the cost of wages per ton of coal carbonized was down to 1s. 6d.; while in the summer, when only three beds were in use, the cost per ton ran up to 2s. 10d. As the number of retorts in use increases, the cost per ton decreases.

At Rushden, the retort-house is of the stage-floor type, and arranged for through retorts when needed; the intention, however, being to extend the house until such time as the machines are fully employed on the one side. The house within the walls is 79 ft. 2 in. long by 64 ft. 3 in. wide. The height from the coke-floor to the stage is 9 ft. 6 in.; and from the stage-floor to the foot-plate of the roof principal, 24 ft. 9 in. The retort-bench is 60 feet long, and 12 ft. 3 in. wide; and the total height from the coke-floor is 19 ft. 9 in. There are six settings of retorts, each consisting of six retorts, 22 in. by 16 in. Ω's, 10 feet long, and heated by simple regenerator furnaces. Each setting has a separate hydraulic main, fitted with gas and tar valves. The width between the front of the benches and the side wall of the retort-house is 22 feet; the 30-feet space at the back of the benches being utilized as a coal-store. There is a space of 3 ft. 9 in. from the front of the benches to the inner rail for the machinery. The coke, as it is drawn, falls through this space to the coke-floor beneath. Each retort is charged with about 3 cwt. of coal every 4 hours 48 minutes; the yield per mouthpiece being about 7500 cubic feet of gas. I have carefully watched the cost of carbonizing week by week. The lowest week was at a cost of 1s. 4·16d. per ton; and the highest, 3s. 3·21d. per ton—the average over the last twelve months, from Oct. 1, 1893, to Sept. 30, 1894, being 2s. 0·09d. per ton of coal carbonized.

Like Mr. Simmonds, we find that the more retorts we have in use, the less it costs us per ton of coal carbonized. Except under very exceptional circumstances, I think it may be taken that it will not pay to instal stoking machinery where the minimum quantity of coal carbonized is less than 3 tons per diem; but that above this the saving at once becomes apparent—in fact, taking the average cost per ton of coal, the wages come to little more than in the case of large works using the same class of machinery.

Discussion.

Mr. HUNT said there was just one observation he might make on this paper. They were told recently by a very high authority that the absence of stoking machinery in a retort-house was an indication of originality. Mr. Lewis had said that, out of some 320 gas-works, there were only 13 in which machinery was employed. One was therefore tempted to remark, what a great amount of originality there must be in the gas profession. He had only one question to ask Mr. Lewis, and that was why he

Lewis) did not adopt inclined retorts, and so save some of the machinery referred to in the paper.

Mr. WINSTANLEY remarked that Mr. Hunt had forestalled him in a question he was going to put. It was well known that he was a great advocate of the inclined retort system; and he could not help saying that a house of the kind referred to by Mr. Lewis, and as shown on the plans, was a very suitable one for the erection of such a system. He thought, too, that, if an erection such as he advocated had been introduced, the saving in labour per ton of coal carbonized, including all charges, would have been proportionately great with one as with a number of settings. In reference to the examples before them, they were told by Mr. Lewis that the increased number of arches charged by machinery decreased the cost of the carbonization of coal, but that a decrease in the number increased the cost. Naturally so, with such a system. As far as his experience extended in the practical working of the inclined system, he found that there was very little difference in the relative cost of working a single setting and a number per ton of coal carbonized. Regarding the figures which had been quoted by Mr. Lewis, he thought it was hardly fair to many gas managers that they could not be given in a different form to that which appeared in the table. The carbonizing wages in various places differed very much; so that he thought to compare one works and system with another, it would be necessary to know what wages were paid. But he admitted it would not be a wise thing to publish the figures, which might possibly cause trouble without being fully understood. He noticed that the table stated the saving between hand labour and machine work as estimated.

Mr. SMITH remarked that, when he was proposing to introduce hand-drawing machines, he wrote to West's Gas Improvement Company, who informed him that, before he could instal their apparatus, it would be necessary to pull down the retort-house, and re-construct it. He (Mr. Smith) was not to be deterred by a statement of this kind; so he wrote Mr. West that he thought it could be done without. He went to their works in Manchester, and had one of the drawing-machines put to the staging; and in this way he demonstrated to them that, by a small alteration in machine and platform, they could introduce the machines into his works. They made the alterations; and the consequence was they had the machines, which had worked very satisfactorily ever since. They had one to each side of the retort-house; and he might add that his retort-house from the face of the setting to the back wall was only 18 feet.

The PRESIDENT said he was sorry they had not had a more animated discussion on this subject, as it was one that interested them all very closely; but he supposed it was because many of the members were not using stoking machinery that they felt indisposed to discuss the paper. He had, however, a little to say upon it. It was well known that he had had West's hand-stoking machines in operation for a number of years; and he was perfectly contented with the results obtained by their working. There was great economy resulting from their use, there was no doubt whatever. There was, of course, a point at which the machines worked at the greatest economy; and he was sorry to say that they could not be brought to work on the same uniform level as inclined retorts. As Mr. Winstanley had said, the cost of working a number of inclined retorts was simply a multiple of one; but this was not so with machines. They had a fixed amount of capital invested in them; and as a machine was capable of doing a maximum amount of work, if that maximum power of working was decreased, the cost per ton of coal would be proportionately increased. The only other point to which he wished to refer, was as to Mr. Winstanley's remarks. He noticed that, while that gentleman said inclined retorts could be worked at a uniform rate up to any number, he did not tell them what was the cost. [Mr. WINSTANLEY: 18d. per ton for labour alone.] Well, they could work hand-stoking machinery at less than that figure. The matter was, of course, one that could only be determined by the circumstances surrounding each case. They could not make any hard-and-fast rule, and say that all works could adopt the same machinery or the same appliances,

Mr. LEWIS, in reply, said he too was somewhat disappointed there had not been a more lively discussion. He had thought that many of the gentlemen present would have had something rather strong to say with regard to the saving claimed; but they had taken it as an accepted fact, which it undoubtedly was. With regard to Mr. Hunt's question, he had expected it; but he anticipated that it would have come from Mr. Winstanley. Three years ago, when he (Mr. Lewis) was inquiring into this matter, he considered the subject of inclined retorts; but at that time, and even now he might say, he did not feel satisfied that the inclined retorts were quite so perfect as some of their advocates had made out. At any rate, the experience he had had of them—an experience limited to seeing them occasionally at several gas-works, as well as Mr. Hunt's experiments—certainly did not lead him to go in for the system. He was not at all satisfied that inclined retorts could show any saving over an installation of machinery such as he had described—in fact, he thought that, if the machines were being worked up to their maximum, or they might take the figures he had given, they would find the cost would compare most favourably with any figures that had been published in connection with inclined retorts. Mr. Winstanley said that the inclined system would be as cheap if only one setting of retorts was being worked as with a much larger number. But he (Mr. Lewis) took it that, with inclined retorts, they must have a certain amount of machinery over and above what obtained with the ordinary hand working of horizontal retorts; and he believed a certain portion of this machinery was common to both systems, and formed a great part of the cost of installing machinery. Taking away this portion, the other part cost very little indeed. Therefore, he could not quite see where the saving came in. Besides, it was not only the actual working—that is to say, actual charging and drawing of the retorts—but the excessive cost for interest, and so on, on the small amount of work done during the lightest part of the year, that had to be considered. The figures which he had given in the paper showed the actual cost in small works; but when they applied the machinery to large works, where it was fully employed, the figures would come out much more favourably.

THE MODERN DEVELOPMENT OF THE GAS-ENGINE.

At the Meeting of the Manchester Association of Engineers last Saturday, a paper on the above subject was read by Mr. J. ATKINSON, M.I.M.E., of Manchester.

The author began by pointing out that the gas-engine is now such an important means of obtaining motive power, that a great amount of time and attention has been paid to its development, with the result that it is a very different machine from what it was some fourteen years ago. He then went on to explain that the scope of his paper was entirely confined to what are known as compression gas-engines, of the type first introduced by Dr. Otto, which was practically the beginning of the gas-engine as a sound commercial article.

The accompanying diagrams (figs. 1 to 3) are drawn to the scale of 120 lbs. to the inch. Fig. 1 is taken from Mr. Dugald Clerk's book on the gas-engine, and has been selected as fairly representing the gas-engine of (say) some twelve years ago. Fig. 2 is a diagram taken from an engine made by Messrs. Crossley Bros., and tested at the Society of Arts trial of gas-engines in 1888. This diagram may be taken as representing another epoch in the development of gas-engines. Fig. 3 is a diagram recently taken at Messrs. Crossley's works, and represents the most modern development of the gas-engine.

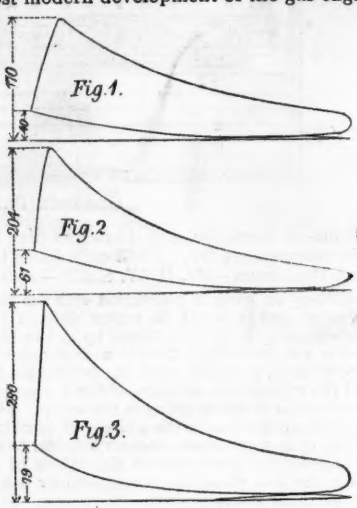


	Fig. 1.	Fig. 2.	Fig. 3.
Diameter of cylinder in inches	9·00	9·50	11·50
Stroke of piston in inches	16·00	18·00	21·00
Revolutions per minute	154·00	160·70	173·63
Mean pressure in lbs. per square inch	71·80	68·10	98·75
Gas per I.H.P. per hour in cubic feet.	19·40	20·55	14·50
Gas per B.H.P. per hour in cubic feet	28·00	23·87	16·49

Proceeding to deal with the diagrams, the author said: Fig. 1 has a mean pressure of 71·8 lbs., probably a higher mean pressure than was common at that time. The gas consumed per indicated horse power was 19·4 cubic feet; per brake horse power, 28 cubic feet. In those days, gas-engines had slides for the admission of the charge and for the ignition. Hence it will be seen that the compression pressure of 40 lbs. is much lower than is common at present; the initial pressure of 170 lbs. being also correspondingly lower. In other respects, it is an excellent diagram. It is, however, obvious that there is some error in the gas consumption per indicated horse power; the difference between 19·4 and 28 cubic feet being certainly much too great. As brake horse power can be taken with very great accuracy, and indicated horse power with a gas-engine is always somewhat doubtful, it would be perhaps as well to take, as is mainly done throughout the paper, comparative trials upon the brake horse power only. The gas used in this instance was Glasgow gas, which is considerably richer than either Openshaw or London gas; and the 28 cubic feet per brake horse power is a better result than if the test had been made with either of the two latter mentioned kinds of gas. Fig. 2 shows a great improvement; the gas per brake horse power being brought down to 23·87 cubic feet. The mean pressure is a little

lower; this being probably partly due to the fact that it was taken during a full-power trial extending over six hours. The improvement doubtless is principally owing to the introduction of the hot-tube ignition, which permits of a higher compression pressure being used, a correspondingly higher initial pressure being obtained, and sundry minor improvements. It is interesting to note that on this trial the proportion of heat-units converted into indicated horse power was 22·1 per cent. of the total heat-units in the gas used in the engine.

Figs. 1 and 2 were taken from engines working on the ordinary recognized Otto cycle. This comprises an outward working stroke followed by an inward exhaust stroke (leaving a chamber of considerable capacity at the inner end of the cylinder filled with burnt gases); then an outward suction stroke, drawing in fresh air and gas, the residuum left in from the previous revolution being still in the cylinder; and then the final compression of the contents of the cylinder, including this residuum. On ignition occurring, the cycle is repeated. Fig. 3 shows a greatly increased mean pressure, 98·75 lbs.; and a greatly increased economy, 16·487 cubic feet, per brake horse power per hour.

Having given particulars as to the "Differential" engine invented and patented by the author in 1885, which embodied some novel features, and was awarded a gold medal at the Inventions Exhibition in that year, he went on to say that its mechanical imperfections were so obvious that its manufacture was given up for the "Cycle" engine. It was almost identical with the "Differential" engine from a theoretical point of view; possessing all the advantages, excepting that the valves had to be mechanically controlled and the ignition was not automatically timed. Its consumption was probably about the same as the "Differential" per indicated horse power; but per brake horse power it was considerably better. Having a gas consumption of only 22 cubic feet per brake horse power, they were the most economical engines then made. Unfortunately, however, from a mechanical point of view, they were still a long way behind; the number of joints being excessive, and the moving parts being more numerous than in an ordinary engine. Wear and tear was consequently greater, and more lubrication was required. It should, however, be pointed out that, at the time these engines were placed on the market, the Otto patent was still in force in England; and they were probably the only ones made which did not conflict with that patent. As a consequence, they had a certain commercial value which was depreciated by the expiration of that patent.

Mr. Atkinson then proceeded to explain by a diagram the means by which the improvement shown in fig. 3 had been obtained, which was, he said, the principal object of his paper. Broadly speaking, it had been effected by getting rid of the burnt gases left in the cylinder at the end of the exhaust stroke. It had been necessary to shape the end of the cylinder so that these gases were completely swept out; and he showed a suitable form on a drawing. As soon as the burnt gases are replaced by pure air, the gas-valve is opened, and an explosive mixture is drawn in during the suction-stroke; the cylinder being thus filled entirely with pure air and combustible gases. The effect of this is shown in fig. 3; the reduction in gas consumption being probably the greatest that has been made by any single improvement in the gas-engine. The invention is a joint one by Mr. Atkinson and Mr. F. W. Crossley.

The author then went on to indicate the other advantages connected with the improved engine; his remarks being as follows: It is known that an ordinary type "Otto" engine working for long periods at its maximum will not give so much power when it is thoroughly hot as shortly after it was started. In the case of improved engine, owing probably mainly to such a considerable volume of cold air being drawn through the combustion chamber, it continues to work as satisfactorily for any length of time as it did on starting. In some instances, an engine has been allowed to run on a brake the whole day; and at the termination, a brake test has been made which proved that the engine was giving as much power as at the start, and with as low a consumption of gas. When engines are worked with weak gases, such as Dowson gas, trouble has sometimes been experienced when the gas has perhaps not been so rich as it ought to have been, owing either to unsuitable fuel being used, or to the gas generator not being properly managed. The mixture, being too uninflammable, gives poor diagrams, and often causes ignitions in the exhaust or air pipes. With the improved engine, however, a greater quantity of gas per revolution can be got into the cylinder and satisfactorily burnt, giving higher mean pressures, and, it may be said, complete immunity from the troubles above mentioned. Ignition also is made more certain and regular from there being no waste gases mixed with the explosive mixture. Fig. 5 is a diagram taken with Dowson gas used in an engine of 30 nominal horse power, giving an indicated power of upwards of 100.

At the first glance, it would be supposed that the improved engine required to be more strongly constructed than an ordinary "Otto" engine. This, however, is not the case; and to explain the reason the diagram fig. 4 is given, also drawn to the scale of 120 lbs. to the inch. This was obtained from an ordinary "Otto" engine of 7-horse power, and will be seen to have a mean pressure of 128 lbs., and a maximum pressure of 366 lbs.; thus showing a greater strain on the engine than the 280 lbs., shown in fig. 3. When gas-engines are working unsatisfactorily—say, with an ignition-tube rather too cold—they occasionally miss igniting a charge. Sometimes this may go on for several revolutions, until finally a cold charge of pure gas and air is ignited, and an abnormally large diagram like this is given. As several charges have been drawn through without being ignited, the cylinder is cold, and the weight of gas and air enclosed is greater than if the engine were working normally; the consequence being that, under these circumstances, it is possible to get a certain maximum strain which is the same for any engine, and this maximum strain is not affected by the improvements. It is therefore necessary to make all gas-engines strong enough to stand this possibly heavy strain, so that, though a higher initial pressure is obtained in the improved engine in regular work than in an ordinary engine, it is not necessary to strengthen any of the parts beyond what they would in any case require; the maximum possible strain being proportional to the compression pressure.

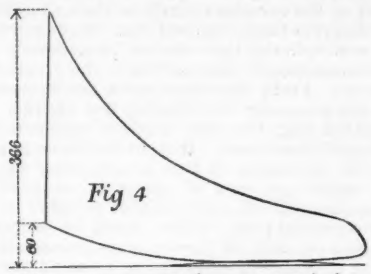


Fig 4

Mean pressure, 128·1 lbs. per square inch.

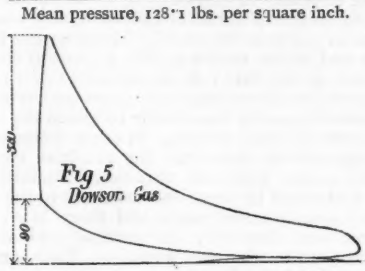


Fig 5
Dowson Gas

Mean pressure, 90·4 lbs. per square inch.

In the appendix, particulars are given of a brake test made with one of the improved engines. The engine had been allowed to run on the full brake load for at least an hour before the actual test was taken; the actual test itself extending over 41 minutes. Fig. 3 is the diagram A mentioned in the particulars. On the trial, the time, the reading of the counter, and the negative pull on the brake were taken for every 50 feet registered by the meter; the misses being counted during the intervals. The gross load was a weight actually lifted and accurately known. The brake rope was carried round the wheel a sufficient number of times to make the negative pull a small amount, which can be accurately read from a widely-marked spring balance.

This is a very satisfactory way of making a brake test of a gas-engine, the accuracy of the test being doubtless correct to a fraction of 1 per cent. By finding the number of revolutions with each certain quantity of gas, and keeping a practically constant load during the test, any errors or anything abnormal is discovered at once, while the test is being made. If you note the number of revolutions given for each 50 feet in the column headed "Difference," you will see that they are practically uniform. The indicated horse power worked out from diagram A, after allowing for the misses, was 46·45; the gas per indicated horse power per hour being 14·177 cubic feet. As previously mentioned, it is not desirable to place too much reliance upon indicated horse power with gas-engines. The strain on the indicator is invariably severe; the temperature may affect the strength of the spring; and there is also considerable risk of a little grit in the indicator cylinder. In this instance, every precaution was taken, and a practically new indicator used. The mechanical efficiency of the engine was 85·9 per cent. In this connection, an incidental advantage of the new improved engine is demonstrated. We have previously seen that it is necessary to construct a gas-engine with strength in its working parts sufficient to accommodate a possible maximum, as shown fig. 4. It is very commonly accepted by engineers that a steam-engine has practically the same amount of friction when simply turning itself round, doing no work, as it has when doing its maximum duty. Experience has also shown that the same rule applies to gas-engines. This being so, a gas-engine of certain dimensions will require a specific amount of power to keep it moving at its normal speed. All additional power is practically effective or brake horse power. Consequently, the greater the power this engine can be made to give out in regular work, the higher its mechanical efficiency will be.

If we assume that Openshaw gas has a thermal value of 640 units per cubic foot, the test showed that 28·26 per cent. of the total units of heat in the gas were converted into indicated horse power—some 6 per cent. more than has ever been done before in a gas-engine, and considerably more than twice as

much as the percentage of heat utilized in the best modern steam-engine of corresponding size out of the heat in the steam supplied to it. Mr. Dugald Clerk recently made a test of a smaller improved engine of 4 nominal horse power, for the purpose of obtaining reliable data for a revised edition of his book, and a brake horse power was obtained for a little less than 17½ cubic feet per hour; the increased amount being due to the engine being smaller.

It will be very instructive to compare the improved engine with the "Cycle" and "Differential" engines. The greatest advantage the latter engines had was doubtless the absence of residual burnt gases in the working charge. This advantage is attained in the improved engine, which does not expand the charge beyond the original volume before compression. In this direction it may be possible to obtain still further improvements, though it is somewhat doubtful. A rough trial has been made with an engine, closing the admission-valve earlier, so as not to fill up the cylinder entirely at the end of the suction stroke. The diagram taken showed that the compression line crossed the atmospheric line almost immediately after the return stroke commenced; thus getting in the greatest possible weight of charge. From the experiment made, there did not appear to be any economy by reducing this charge, though it must be admitted that the trial was not conducted so completely as it might have been. It is to be borne in mind that, by increasing the expansion in this or any other way, a larger cylinder and engine per unit of power is required. Consequently, the mechanical efficiency cannot possibly be so good; and, from a commercial point of view, it will be understood that the cost of engine per unit of power is an important element. All things being considered, and bearing in mind the excellent result obtained, it is very doubtful indeed if any material all-round gain can be made in this way. The pressure left in the cylinder at the end of the stroke in the improved engine is by no means wasted, seeing that it is employed in driving out the exhaust, and does the scavenging in the manner explained.

Attempts have frequently been made to attain the same ends in "Otto" engines by other means. In some instances, pumps have been employed to draw out the residual gases, or in other cases to pump fresh air through. Doubtless better results can be arrived at by these methods; but in the improved engine there are no additional parts, and there is no increased cost in construction. Certainly the exhaust-pipe is in many instances longer than it otherwise would be. Taking an average case, it would probably be from 20 to 30 feet longer; but the additional few feet of pipe necessary is not a large item. It is satisfactory to note that silencers packed with gravel, or quieting chambers, such as are commonly used, do not affect the result any more than they do with ordinary engines. From some tests which have been made on this point, the gas consumption per brake horse power was not increased in the slightest degree by the silencers. It is necessary that they should be placed at the end of the exhaust-pipe, and that the pipe itself, from the engine to the 65 feet, or whatever may be necessary in the particular case, shall be uniform, and not broken into by any larger chamber. Moderately-sized pockets for collecting water may be used without any disadvantage in any part of this pipe.

[Appendix.]

Particulars of Brake Test.

Time.	Counter.	Difference.	Negative Pull.	Misses.	Remarks.
h. m.					
0.00	24,042	—	11½	—	Diagram A.
4.42	24,834	792	11	12	Less gas.
9.20	25,631	797	12½	14	Diagram B.
14.00	26,424	793	12½	11	Gross weight lifted amounted to [542 lbs.
18.40	27,206	782	12½	7	
23.20	27,996	790	14	7	Readings taken at every 50 c. ft. [of gas.
27.00	28,786	790	14½	7	
31.38	29,579	793	14½	8	Circumference of fly-wheel, in- [cluding rope, 14·35 ft.
36.18	30,366	787	13½	10	
41.00	31,161	795	13½	9	Height of barometer, 29·8 in.
		7119	10/130		
			13		

Total revolutions 7119 ÷ 41 = 173·63 revolutions per minute.

542 − 13 = 529 lbs. net load.

(173·63 × 529 × 14·35) ÷ 33,000 = 39·91 brake horse power.

50 × 9 = 450 cubic feet of gas in 41 minutes.

(450 × 60) ÷ 41 = 658·5 cubic feet of gas in one hour.

658·5 ÷ 39·91 = 16·487 cubic feet per brake horse power per hour.

In the discussion which followed the paper,

Mr. Jenkins referred to the policy of corporation gas committees and companies in connection with the working of gas-engines, which, he observed, could be used for many other purposes if the price of gas were reduced. For instance, in the case of the electric light, it seemed impossible for electricians to transmit the power to very long distances; whereas, if the price of gas were reduced so that gas-engines could be widely adopted, they might be started in hundreds of districts to distribute electricity over a group of short streets. Mr. Denny Lane, of Cork, had proved that such a scheme would be advantageous, as compared with the steam-engine. He would like to know whether the increase of compression pressure from 40 to 79 lbs. had any detrimental effect upon the mechanical efficiency of the gas-engines when working at reduced power.

Mr. S. Boswell said he should be glad to be told of any method by which the compression could be reduced without altering the efficiency of the engine.

Mr. Guthrie thought the alterations introduced recently in the gas-engine were sound in every direction.

Mr. D. Fulton, commenting upon the introduction of a long exhaust-pipe, said he would like to know whether it would necessarily have to be made straight, as in many cases this could not be accomplished. The author would have done better to have given some details as to the working of his engine under intermittent loads, as its economy would then be more clearly understood. It was acknowledged that there was a greater load thrown upon the piston in expelling the air during the idle strokes between the explosions than in expelling the exhaust during the explosion. He thought that, with this long exhaust-pipe, the increase of friction in the pumped-out air when getting away would tend to throw still more load upon the piston in expelling the air; and with regard to the author's method of getting rid of the residual products, might it not happen that, on the in-charging stroke, some products would be drawn back into the cylinder from the exhaust-pipe?

Mr. A. Saxon said he did not think the brake efficiency of a gas-engine would equal that of a steam-engine. It was certainly a peculiar feature about the gas-engine made by Mr. Atkinson and Mr. Crossley that the exhaust opened so early and closed so late; and he thought these gentlemen might be congratulated on having devised a workable method for getting rid of burnt gases.

Mr. Craven gave some interesting particulars of the working of a 20-horse power gas-engine made by Crossley Bros., developing 30-horse power, which he had put down in his works. This engine drove a 15-ton overhead rope-driven travelling crane, and about 40 machine tools of various kinds, such as were used in an ordinary engineering shop. The consumption of gas in this engine was 500 feet per hour; and the cost averaged about ½d. per horse power per hour. In comparing the gas-engine with the steam-engine, they must remember that in the former no stokers were needed, and hardly any water was consumed, while there was no carting away of ashes, cleaning of boiler flues or other similar charges.

Mr. E. Constantine observed that, though testing by the brake was, no doubt, the proper way, the horse power had to be considered. Taking an "Otto" engine consuming 14·5 cubic feet of gas per 1-horse power, the cost, at 2s. 6d. per 1000 cubic feet, came to 0·435d. per horse power per hour. A steam-engine working at 40 lbs. of steam per horse power and 8 lbs. of water evaporated per pound of coal in the boiler cost 0·4d. per horse power per hour, with coal at 15s. per ton. A large cotton-mill engine averaged 0·138d. per horse power per hour; while with a triple expansion engine, taking a consumption of 14 lbs. of water per horse power per hour, and an evaporation of 9 lbs. of water per pound of coal, the cost was 0·125d. per horse power per hour. One disadvantage in a gas-engine for small users was that, if it was necessary to increase the power, an entirely new engine would have to be procured, and little or nothing could be obtained for the old one.

Mr. Daniels remarked that he should certainly recommend a gas-engine for driving in a locomotive or machine works in separate bays.

Mr. Atkinson, in replying upon the discussion, said he had had considerable experience with regard to gas companies. In many towns, there was a strong feeling that the price of gas should not, as now, be put up beyond its actual cost of production, as this militated strongly against the more rapid extension of gas-engines; and he had found the companies very chary about buying gas-engines, notwithstanding that, when he was in London, the Gas Companies there were receiving about £12,000 per annum in gas-rental for engines his firm alone—and it was comparatively only a small establishment—had put down. With regard to the increase from 40 lbs. to 79 lbs. in compression, he might observe that, in the former case, it was difficult to keep the slides of the gas-engine tight; and this necessitated a limit being made to the compression pressure. When the slide was done away with, and the ignition-tubes introduced, they could easily get a higher pressure. As to the exhaust-pipes, these could be made with any reasonable number of bends; but there must be no elbows. With regard to the difficulty referred to by Mr. Constantine, as to the impossibility of increasing the power of a gas-engine, the only thing to do was to have a good margin.

The proceedings closed with a vote of thanks to the author of the paper.

Society of Arts—The 141st session of this Society will commence on the 21st inst., with an address by the Chairman of the Council, Major-General Sir J. Donnelly, K.C.B. We note that the arrangements include six courses of Cantor Lectures; the first being by Professor Vivian B. Lewes, on "Explosives." The second paper in the session will be by M. Hermite, who will deal with the "Electrical Treatment of Sewage."

THE DIFFUSION OF LIGHT FROM DULL SURFACES.

Herr Christian Wiener has contributed to Wiedemann's *Annalen* the results of an investigation of the phenomena of the reflection—or, as he prefers to call it, the diffusion—of light from dull surfaces. This inquiry was suggested to Herr Wiener by the problem which presented itself to him in connection with the teaching of descriptive geometry, of representing bodies with their appropriate degrees of brightness. The author begins by stating the accepted law that the intensity of illumination of an element of an illuminated surface is proportional to the intensity of the source of light divided by the square of the distance from the element, multiplied by the cosine of the angle of incidence. The brightness of the illuminated element as it appears to the eye of an observer is proportional to the intensity of illumination thus arrived at and to its own reflective capacity. According to Lambert's law, this brightness is the same for all angles from which the surface may be viewed. That this law is not always true, was known to Bouguer, who found (in a manner corroborated by Herr Wiener) that when the direction of incidence and of vision are nearly parallel, the brightness is not proportional to the cosine of the angle of incidence, but that with increase of this angle it decreases more rapidly than the cosine. In shaded drawings, Lambert's law is employed almost exclusively, and with good effect. The author refers to the investigations of Herr Lommel, recently abstracted in this column (see *ante*, p. 777), as starting with Fourier from the supposition that the diffusion of light by a body does not proceed from the surface, but from volume elements of the mass of the body, as the colouring of the diffused light demands. For opaque glowing bodies, Lommel thus arrives at the law of the cosine. He also finds that the length of the path described in the interior of a body by a ray of light before its complete absorption depends wholly upon the absorptive power, not upon the angle of emergence; so that the vertical depth of this diffusing layer, and consequently the amount of the diffused light, must be proportional to the cosine of this angle. This result was confirmed by Herr Möller by observation of glowing metal plates. In his later paper, Herr Lommel arrives at a formula for the intensity of the reflected light, which depends only upon the angles of incidence and emergence. These results are based upon the tacit assumption that the surface dealt with is matt, or rough. And for such surfaces they are perfectly confirmed by Angström's observations on the heat radiation of plane surfaces.

The explanation of the diffusion of light by dull surfaces has been based upon two assumptions. The first is that the disturbance penetrates the surface to a certain depth, and that this layer radiates the disturbance in all directions. This view is supported by the colour shown by the dull surfaces, and by the fact, ascertained by many experiments, that the diffusion increases, within certain limits, with the thickness of a specially prepared dull layer. Bouguer employed a different hypothesis upon which to base his theory of the diffusion of light. He supposed the rough surface to be composed of a large number of small plane reflecting surface elements lying in all directions, like a tumbled mosaic. He further supposed the total area of these surfaces in a given direction to be greatest in that of the general surface, decreasing as the angle to it increases; thus producing a preponderating reflection in the sense of the effect of the general surface. Herr Wiener holds that in the case of dull surfaces we have to deal both with penetration of the rays and diffusive reflection from small surface elements; but these conditions vary so with different degrees of roughness, and different forms of the prominences offered by rough-surfaced bodies, that observation alone will determine the facts for every case.

Herr Wiener began with observations upon the diffusion of light in the case of cast white gypsum, of which two equal plates 25 centimetres square were procured and illuminated in a dark room by a single standard stearine candle of six to the pound. As the unit of brightness, he adopted that shown by such a plate when illuminated perpendicularly by a candle, at one metre distance, seen perpendicularly or very nearly so. The distance of the observer's eye from the plate has no influence upon the brightness. The direct vision of the light was prevented by the interposition of a screen. Several observations were made of the effect of varying the distance of the light and the angles of incidence and emergence upon and from the plates. From these the author has drawn conclusions which apply only to cast gypsum, but not to rough surfaces in general. Concerning the diffusion of light by gypsum, it may be stated: (1) With a constant angle of incidence and an angle of emergence varying between 0° and 60°, the brightness is pretty uniform, and usually somewhat smaller than that demanded by Lambert's law. (2) As the latter angle increases from 60° to 90°, the brightness on the whole diminishes, and at the latter limit, or with a glancing visual ray, it is about 0·6 times that at angle zero. (3) On the side opposite to the incident ray—*i.e.*, on the side of reflection—the brightness is greater than at the corresponding points of equal angle of emergence on the same side. (4) The reflection is more pronounced and evident the larger the angle of incidence. It is therefore noticed that reflection is always greatest with an angle of emergence slightly larger than the angle of incidence. These considerations are not without their bearing upon the construction and use of photometrical instruments.

REGISTER OF PATENTS.

Protecting Gas-Burners and Preventing Waste of Gas.—Dixon, T., of Steeton, Yorks. No. 23,009; Nov. 30, 1893.

This so-called "invention" is attained by forming of flexible material—such as india-rubber—a cap, the internal diameter of which is of such size that, when it is placed upon a gas-burner, it will slide down and fit tight to the circumference of it; thus protecting the holes or slit in the burner, and "keeping them clean and ready for use, by preventing dust or the like getting into the same and stopping them up." In addition to preserving the burners, should the tap in the bracket be leaky or left open, the escape of gas is prevented, and "the danger of filling the room with gas, with probable disastrous results, minimized." The outer circumference of the cap is either plain or corrugated; and the stopped end is provided with a loop or the like, to which may be attached a cord or chain "for securing the flexible cap to the gas-bracket or other convenient fixture."

Gas or Internal Combustion Engines.—Crossley, F. W., and Atkinson, J., of Manchester. No. 23,075; Dec. 1, 1893.

This invention relates to the valve-gear of gas or other internal combustion engines, working on the "Otto" cycle; and its object is to operate the necessary valves direct from the crank-shaft instead of a side shaft driven by gearing at half the speed of the engine, as is now commonly done. It also relates to means for keeping the exhaust-valve cool.

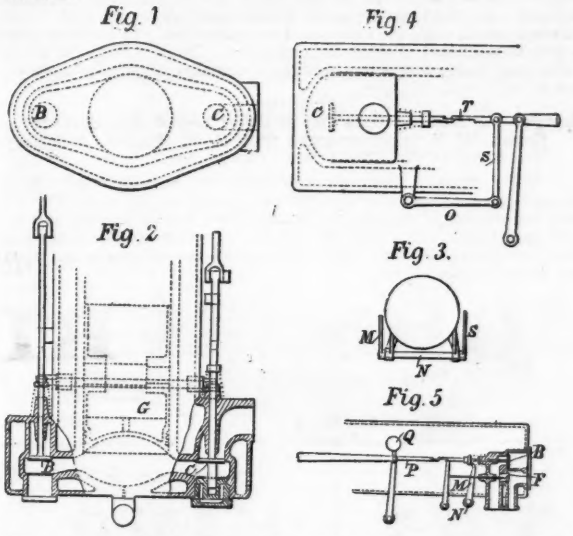


Fig. 1 is an end elevation of the engine; fig. 2, a plan partly in section; fig. 3, an end elevation; fig. 4, an elevation of one side; and fig. 5, an elevation of the other side partly in section.

The usual valves in an engine of this type are the charging-valve B; the gas-valve F; and the exhaust-valve C. The invention is for controlling these by one or more eccentrics or cams (the arrangement shown in the drawings is by two eccentrics), which make a complete movement once for every revolution, though the engine requires two revolutions to complete its cycle.

With respect to the charging-valve B, it may be allowed to be sucked open by the outward movement of the piston G during a suction or charging stroke; and as the gas-valve F is shut off from the cylinder by the charging-valve B, it may be opened every revolution without disadvantage, so long as working strokes are to be made—it being understood that a suitable regulating arrangement is applied to the gas supply, so as to prevent the gas being at any material pressure above atmospheric pressure.

The exhaust-valve C, which is operated by an eccentric, must not be opened at each revolution; being always left closed on the inward or compression stroke following a suction stroke. During this suction stroke, a combustible mixture has been drawn in; and for the purpose of preventing the opening of the exhaust-valve C at improper times, a connection is provided, preferably operated by the stem of the charging-valve B. It acts upon a catch or distance-piece T, in such a manner that each time the charging-valve B is opened, the lever M, operating through the shaft N, lever O, and distance-piece S, moves the catch T aside, so that the eccentric, which operates the exhaust-valve C, does not open it at the following stroke.

If only one eccentric is used for opening the exhaust-valve C, gas-valve F, and charging-valve B, the motion which operates the exhaust-valve may be taken off from the eccentric at a different angle from that which operates the gas-valve and charging-valve, so that each may thus be suitably timed.

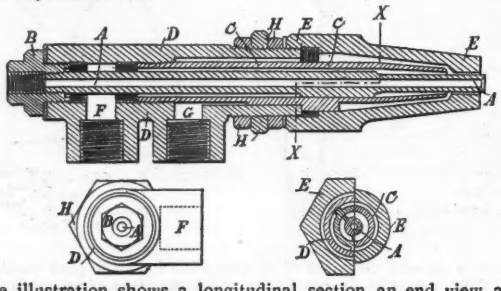
Any suitable governor may be used (in the drawings an inertia governor Q is shown), by deciding whether the gas-valve F shall be opened during charging strokes, or miss opening it when the engine would otherwise run too fast. When the gas-valve F is not opened, the piston G may be allowed to draw air only into the cylinder, to be compressed, re-expanded, and then exhausted. Otherwise, by another arrangement (and this is the arrangement shown in the drawings), when working strokes are not to be made, the gas-valve F is not opened by the striker P of the governor Q; but the striker, being thrown upwards by the action of the governor at the reversal of the motion at the end of the stroke into the position shown in fig. 5, opens the charging-valve B mechanically, instead of the gas-valve F, at about the commencement of the suction stroke. When thus opened, the charging-valve B is kept open during almost the whole of a complete

revolution of the engine; so that on the return inward stroke no compression takes place, but the air previously drawn in is driven back through the valve B into the air pipe or chamber from which it was drawn. The charging-valve B having been opened, the exhaust-valve C is not operated. The engine thus continues drawing in and expelling air until the governor Q deciding that a working stroke is required to keep up the speed, the striker P is allowed to open the gas-valve F, instead of the charging-valve B. In this case, the suction of the piston automatically opens the charging-valve B, draws in an explosive charge, which is compressed on the return inward stroke, ignited so as to give a working pressure on the outward power stroke, and then exhausted by the following inward stroke; the exhaust-valve C being opened because the charging-valve B was not opened on the previous power stroke, as previously explained. Power strokes are given at each second revolution, so long as the striker P opens the gas-valve F; but idle revolutions only occur when the charging-valve B is opened instead. The latter arrangement has the advantage of allowing a power stroke to follow an idle stroke a revolution earlier than by the other arrangement, or than is the case with engines (as usually constructed) with the valves operated in a cycle of two revolutions.

The exhaust-valve C, usually of the mushroom type, frequently gets very hot in working; and, especially in large engines, it is sometimes so hot as to fire the charge prematurely. To prevent this, the patentees arrange that its head, or a substantial projection on its head, moves in a cavity which protects it from direct contact with the rapidly moving hot gases during exhaust, and partly also from the heat during the working stroke. As shown in fig. 2, the cavity in which the valve-head moves is constructed in the cover to the valve, and is water jacketed; and the large projection being cooled by contact with water jacketed metal, cools the valve-head by conduction. In extreme cases it may be necessary to make the projection as large in diameter as the valve-head itself; but, in most instances, a smaller projection (as shown) will be sufficient.

Sprayer for Burning Coal Tar or Other Liquid Hydrocarbons.—Cowan, W. H.; communicated from B. H. Peacock, of Sydney, New South Wales. No. 23,162; Dec. 2, 1893.

This invention is especially applicable for burning coal tar in furnaces for heating gas-works retorts and boilers. It is constructed after the manner of an injector (the tar being forced into the furnace and sprayed therein under the influence of steam pressure), and consists essentially of three tubes, the one within or outside the other, and an adjustable nozzle.



The illustration shows a longitudinal section, an end view, and a cross section on the line X X.

The innermost, or air-tube A is screwed at one end into a plug B, provided with a back nut, so as to enable the tube to be adjusted and cleaned. The other end is made wide in the bore, as shown. The tube is kept central within the surrounding tar-tube C, by wings or guides. The tar-tube (screwed at one end) is fixed to the outer tube or casing D, and is held central within the casing by wings or guides, in such a manner as to keep the front end of the tar-tube concentric with the air-tube A and nozzle E. The bevelled end of the tube C thus acts as a valve against the nozzle E of the burner. The wings or guides of the tube C are cut away, so as to fit within the recess of the casing D, and so prevent any lateral movement being given to the tar-tube.

The outer tube or case D is formed with two inlet-connections F G—the former for tar, and the latter for steam. The case is also screwed at one end, to retain the air-tube A, by means of the screwed plug B. It is also screwed near its centre, between the inlets F G, for the purpose of holding the back end of the tar-tube C. And further, it is screwed at its front end, so as to receive the adjustable nozzle E and adjusting-nuts H. The nozzle E is preferably formed hexagonal in shape on a portion of its outside, so as to admit of easy adjustment; and the nozzle E is so bored at its outlet-end as to form a valve seating for the bevelled end of the tar-tube C. The nozzle is retained in the desired position by the back nuts H, which also form (through the medium of a washer) a tight steam-joint against the inner end of the nozzle E.

The whole arrangement thus forms a burner or sprayer, the action of which is as follows: A constant pressure of steam is passed in at the inlet G; and, after flowing along between the tar-tube C and the casing D, it comes in contact with a constant pressure of tar at the bevelled end of the tar-tube and bevelled portion of the nozzle E. It passes thence out through the nozzle, after which the steam and tar expand, and draw a quantity of air through the air-pipe A, so as to cause combustion to take place inside the spray, and "enable the tar to be consumed in much less time and space than in the manner hitherto employed." The quantity of tar passed into the furnace is under the control of the steam—that is to say, if the pressure of steam be increased at the steam-inlet G, the quantity of tar passed will be decreased, and *vice versâ*.

Coin-Freed or Prepayment Gas-Meters.—Sharp, J., of Glasgow, No. 6169; March 27, 1894.

The special claims for this invention in coin-freed gas-meters are: (1) The arrangement and combination of the operating mechanism on a single horizontal spindle and portable framing; (2) the construction and arrangement of a coin-receiving organ on the horizontal spindle, and an outer sleeve organ turned by the coin to operate the gas-freeing mechanism; (3) the fitting of a segmental toothed wheel on the sleeve-turning or coin-freed organ, in combination with a loose segmental toothed wheel, made adjustable to suit the varying price of gas; and (4) the fitting of a rotative sleeve formed with a differential coiled slot or cam groove, in combination with a pin and sleeve capable of combined rotative and longitudinal movement, and having connecting gearing and fittings to set on and stop the movements of the meter.

Fig. 1

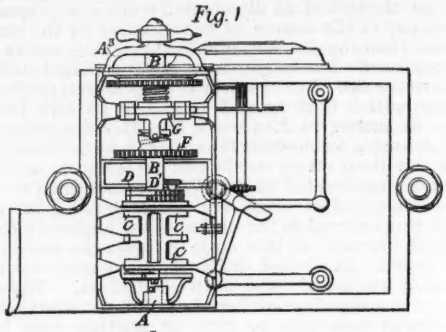


Fig. 2

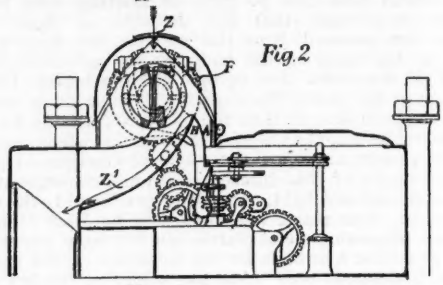


Fig 3

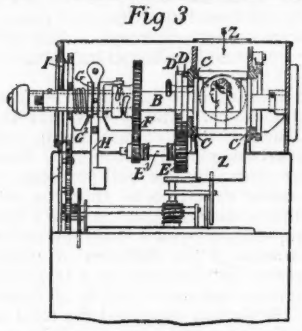


Fig 4

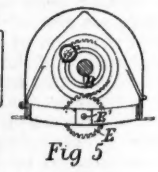


Fig 5

Fig. 1 is a plan of the meter, with the top removed, showing the arrangement of coin-freed mechanism as applied to a dry gas-meter Fig. 2 is a transverse vertical section through the coin-receiving organ. Fig. 3 is a longitudinal section at right angles to fig. 2. Fig. 4 is a transverse section, showing the adjusting segmental wheels to suit variations in the price of gas. Fig. 5 is a corresponding view of a ratchet toothed wheel and pawl and brake connected to the rotating mechanism.

The whole mechanism is carried on a light open framing, in the upper part of the meter-case. A horizontal oscillating main spindle B is mounted longitudinally in the framing; its front end being carried in the central bearing of a bow-shaped bracket in the end plate, while its inner end is carried in a socket on the inner face of the end of the framing. A projecting pin on the spindle is made to come against stops in the bearing A at the extreme travel limits of the spindle in its to-and-fro oscillations; and the spindle is made to carry all the essential operating mechanism.

The spindle is turned by a handle on its outer front end, after the insertion of each coin within a slot Z in the meter-case; and it revolves a half, or rather more than a half, revolution. A pointer on the spindle indicates by its positions opposite fixed graduations on a dial-plate, on the front of the bow bracket A^3, the starting position of the turning handle and the stopping position to which it should be turned. A vertical hollow coin receiving and holding chamber is fitted to the horizontal spindle, preferably towards its back end; and this chamber is formed with end discs, and with a series of vertical projecting feathers or ribs on its two opposite inner open sides, and a central one between them on the opposite side, with a longitudinal rib connecting the two sides at the lower centre—all so as to guide the coin inserted into its proper receiver, while any coin of insufficient size would pass through into the hollow chamber, and have no actuating effect on the mechanism. An annular outer hollow casing or mantle is mounted loosely over or round the coin chamber, preferably consisting of semi-circular rings C, with connecting ribs at the ends of the segments, and having a slot through it in line with the slot in the holder and with the coin-inserting slot Z in the top of the meter-case.

If the handle on the horizontal spindle be turned when no coin is inserted, or one of insufficient size, it will do so without acting on the outer annular case C, or operating the gas-supply mechanism. Consequently no passage of gas to the customer can take place. But when the regulation coin is inserted through the slot Z in the meter-case, it drops down through guides, and passes into the chamber holder,

where its lower end bears on a centre bead and its side surfaces rest between the vertical feathers, while its top end will project up within the slot in the outer annular casing. If the primary hand-spindle B be now turned, the coin will, by its bearing surface, turn the outer annular casing C, along with the holder on the spindle, until the latter has made a half or nearly a half revolution, and come to its stop position, when the coin will drop out through the slot in the holder and annular casing C into a receiving angled shoot Z, and pass by gravity into a coin-receiving locked box on the meter-case. This action of turning the annular casing C will also operate power-transmitting mechanism to pass a measured quantity of gas through the meter.

A ratchet toothed wheel is mounted on the disc end of the annular casing C; and a spring-acting pawl (fig. 5) bears on it, so as to make the casing C always move in the forward direction, and prevent it slipping back on the return oscillation of the coin-holder. Projecting spring-wire or other lugs are fitted to bear on the side of the wheel, and act as a brake to prevent "slip" in the event of the bearings getting worn. Two segmental spur toothed wheels D D^1 are mounted over the other end disc of the casing C, on the opposite side of the spindle and coin-holder to that of the ratchet-wheel. One of these wheels D is fixed to the casing C, and the other D^1 rotates loose, but is capable of being fixed in any desired adjusted position. Teeth would be formed at two opposite segments of each of the wheels, so as to drive always in the same direction when put in motion at each half revolution of the annular casing C. The teeth of both wheels would be capable of gearing into the teeth of a broad spur pinion E, mounted on a short horizontal spindle below them; and the loose segmental wheel D^1 can be turned and adjusted in relation to the teeth in the fixed wheel D, and then fixed by a screw head to regulate the number of teeth and the length of travel which these wheels shall have when gearing into the pinion E. This transmits a degree of motion proportionate to the varying price of gas in any district; and the disc on the end of the sleeve C would be graduated to show the distance between it and a fixed mark on the loose wheel, and illustrate to the eye in (say) cubic feet measurements the volume of gas being supplied for the time being for a specified coin.

A spur pinion E^2 would be mounted on the opposite end of the short rotating spindle E^1 to that of the spur pinion E; this would gear into and drive a spur wheel F, secured to a sleeve carried on a hollow spindle, mounted loosely on the main central spindle B. This sleeve is formed with a differential coiled or cam slot, in which works a pin fitted in the arm of a sleeve G, mounted on a hollow spindle and secured to turn round with it by a longitudinal feather and groove joint. This hollow spindle has a spur-wheel connected to it—termed by the patentee the "prepaid-gas wheel."

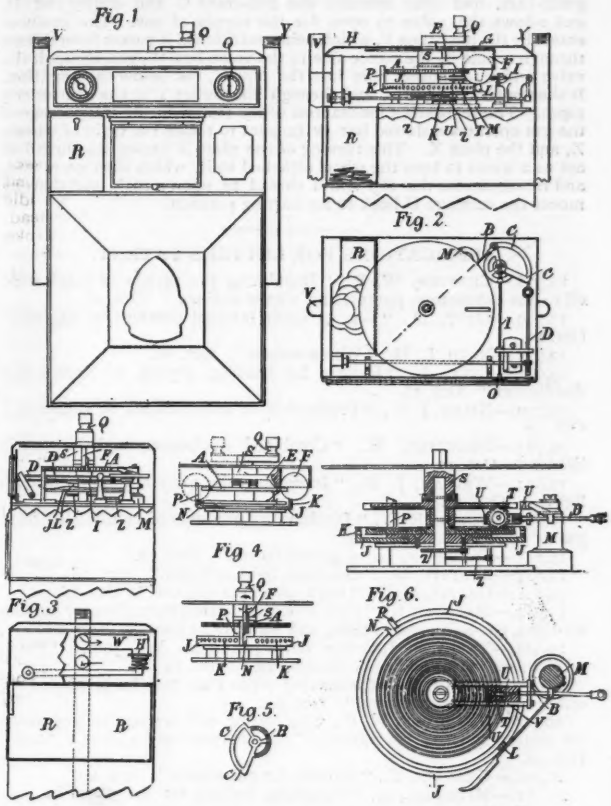
When coins have been inserted in the meter, the mechanism is set in motion; and the wheel F and its sleeve are turned proportionately round, so that, if the maximum quantity of gas has been prepaid, the pin will come against the end stop of the groove, and prevent further rotation of the wheel. As gas is being consumed, the wheel on the hollow spindle and sleeve G will rotate, and the pin will follow in the groove until all the prepaid gas has been consumed. It will then slide into the stop position of the groove; the latter action being assisted by the recoil of a helical spring, so that the sleeve will slide on the spindle. A lever or vertical arm H, with a toothed-shaped lower end, is fulcrumed to oscillate at its fork-shaped upper end by a transverse pin passing through eyes in it and in cheek projections on the fixed framing. Screw pins are fitted on each side, to project through the forked part of the lever H, and fit within a grooved or recessed part of the sleeve G. This enables the latter to rotate without acting on the pins; but when the sleeve receives its longitudinal movement on its spindle (when the prepaid gas has been consumed), it acts on the pins and gives a corresponding travel or oscillation to the lever H, so that its lower end will come in the path of, and stop the arm on, the ordinary worm spindle actuated by the bellows, and so stop the action of the meter.

The prepaid-gas wheel gears with a pinion; and through a train of the usual wheel gearing, it works in unison with the ordinary wheel of the meter-index, which indicates 100 cubic feet per revolution. In this way, the ratio may be made so that one revolution of the prepaid gas consumption wheel will correspond with three revolutions of the last-mentioned wheel, and thus indicate 300 cubic feet of gas. A graduated dial I, to indicate cubic feet of gas, is fitted to the front of the prepaid-gas wheel, and is visible through glass in front. When a series of coins are inserted through the slot in the meter, and the mechanism set in motion, and the slotted sleeve turned, the pointer will also be turned a corresponding amount, and indicate by its position in front of the dial the volume of gas prepaid and unused. As the gas is being consumed, the prepayment wheel will revolve, and with it the sleeve G and the hollow spindle on which it is fixed. The dial I will consequently be carried round; and by its graduations and distance from the then position of the pointer, it will at any time show in cubic feet the volume of gas still to be used.

Coin-Freed Apparatus for the Sale of Gas.—Glover, R. T. and J. G., of St. John Street, Clerkenwell. No. 8327; April 26, 1894.

It is claimed by the patentees that the object of their invention is "the construction of apparatus of relatively small size for use in connection with gas-meters, upon, or to which, it is fixed in such a manner that a consumer wishing to obtain a supply of gas must prepay the same by the insertion of a coin of given size and value, which, acting as a key, enables the consumer, by turning a handle, to open a valve for the passage of a proportionate quantity of gas to the service-pipes."

Fig. 1 is an external front elevation of the complete meter. Fig. 2 is a front elevation of the apparatus as applied to the top of a meter, the inlet-pipe and enclosing case of which is in section; also a plan of same with the handle and top of the meter case removed. Fig. 3 is a side elevation of the apparatus (the meter case being represented as broken away), and a part sectional elevation looking to the left, to show the action and position of the gas inlet-valve. Fig. 4 is a part sectional elevation, showing the position of the coin when inserted, and an elevational view of same, taken at right angles, showing the coin in a position to fall through the escape slot when the handle has been turned to the position represented by dotted lines in the upper view. Fig. 5 is an under plan of the bell-crank lever and crown-wheel shown in top plan in fig. 2. Fig. 6 is a sectional elevation and sectional plan of fig. 2. on an enlarged scale.



The invention primarily consists in a circular plate A with a number of notches upon its periphery; and forming a spiral groove upon its under side from the centre to the edge. Above the plate A, and loosely mounted upon a central spindle, is an arm E and coin-pocket F, so arranged that, upon the insertion of a coin of given size through the slot G of the meter-case, it falls through a shield into the coin-pocket, and one of the notches of the circular plate, and on to the upturned edge of a divided table J, which is marked off into a given number of divisions—in this case fifty—and having a corresponding number of holes K for the reception of a spring pin L that is fixed at one end to the pillar M. A slot N is cut in the upturned edge of the table J; and immediately contiguous to it is a stop P, against which the coin-pocket F strikes when turned, as shown more particularly in figs. 5 and 6.

Each hole K in the table J is equivalent to a cubic foot of gas; so that the amount of gas to be delivered for a given coin can be easily altered, to suit the varying prices of gas in different districts. This is accomplished by withdrawing the pin L, and turning the table J round, so as to move the escape-slot N and stop P a greater or less number of divisions away from the pin L—thereby determining the amount of turning movement of the plate A. If the holes K in the table J are numbered consecutively from the escape-slot N round to the stop P, the number of feet of gas to be passed for a given coin will correspond to the number of the hole in which the spring pin is inserted.

The table J is so placed as to cause the penny to rest upon its edge, and to be partly in the coin-pocket F and partly in one of the notches of the circular plate A. It thus acts as a key to lock the coin-pocket F and plate A, and cause them to move together when the handle Q fixed to the square end of the coin-pocket boss S is turned.

A wheel T pivoted to a sliding carriage U, held between guide-bars, gears into the spiral groove cut on the under side of the circular plate A, and also into a similar spiral groove formed upon the top of a plate X, arranged below the wheel T. The plate A is free to revolve upon its central spindle; but the bottom plate X is fixed thereto, and revolves with it when operated by the meter mechanism. Its relative rate of rotation is governed by a train of wheels Z, interposed between the meter mechanism and the spirally grooved plate X—the connection between the meter-registering mechanism and this train of wheels being effected by means of a slotted bar.

A rod B is attached to the wheel carriage U at one end; the other end being connected to a bell-crank C, which, when moved, causes the sliding rod D to move to and fro, so as to effect (by means of the lever and rod) the opening or closing, as the case may be, of the gas-valve H, which is loosely articulated to its stem by a ball and socket or universal joint. The bell-crank C is formed with part of a crown wheel that, gearing into a pinion fixed to the small spindle I, rotates same to cause the pointer O to move over the indices of the dial, to indicate to the consumer the amount of gas prepaid, or remaining unconsumed.

A person wishing to obtain a supply of gas inserts a coin; and, by turning the handle Q, he causes the spirally-threaded notched plate A, by the engagement of the coin in one of its notches, to turn a distance determined by the position of the coin-pocket stop P and escape-slot N, through which the coin falls into the till R. This position

varies according to whether more or less gas is to be supplied for a given coin, as already explained. This turning of the plate A causes its spiral thread to act as a worm to turn the wheel T, which gears into and moves over the bottom spiral as upon a rack. It thus moves the carriage U, to which the wheel T is pivoted inwards upon the guide-bars, and thus operates the bell-crank C and sliding-rod D, and allows the valve to open for the supply of gas. The gas now enters by the inlet-pipe V, which being partitioned it passes from thence through a hole in the meter side to the valve-box W, and through the valve orifice to another hole into the pipe V, but below the partition. It then enters the meter, and through the outlet Y to the consumer's pipes. The registering mechanism of the meter during the passage of the gas operates a slotted bar or tangent to rotate the train of wheels Z, and the plate X. This turning of the plate X causes its thread to act as a worm to turn the wheel attached to it, which then gears into, and moves across the top spiral thread as upon a rack, and thereby moves the carriage U back to its starting position.

APPLICATIONS FOR LETTERS PATENT.

19,578.—CHESTER, W. R., "Regulating the supply of lubricating oil to gas-exhausters, pumps, and rotary engines." Oct. 15.

19,589.—DAVY, D., "Gas or other internal combustion engines." Oct. 15.

19,635.—NASH, L. H., "Water-meters." Oct. 16.

19,691.—LYLE, J., "Retorts for heating, drying, or destructive distillation." Oct. 16.

19,770.—RILEY, J. E., "Production or manufacture of ammonia." Oct. 17.

19,785.—DRUEDING, H., "Combined gas-burner and automatic lighter." Oct. 17.

19,812.—WIGHAM, J. R., "Increasing the efficiency of lighthouse lights." Oct. 18.

19,844.—BURNE, E. L., "Discharging products of combustion from gas or oil engines." Oct. 18.

19,845.—PATERSON, J., "Gas-regulators." Oct. 18.

19,864.—EPSTEIN, M., "Gas glow-light cylinder." Oct. 18.

19,894.—HARRIS, H. G., "High-speed gas-engines." Oct. 18.

19,944.—MALABAR, R., "Cast-iron and earthenware pipes for making air-tight, gas-tight, steam-tight, and water-tight joints." Oct. 19.

19,981.—TANGYES LIMITED and JOHNSON, W., jun., "Valve mechanism for air and gas compressors." Oct. 19.

20,027.—WIGAN, R., "Connecting pipes that may be employed for either high or low pressure." Oct. 20.

20,046.—THOMPSON, W. P., "Indicating and registering apparatus for meters and like mechanisms." A communication from P. Marix. Oct. 20.

20,056.—GERLACH, C., "Burners for gas-stoves." Oct. 20.

20,061.—MITCHELL, J., "Fastening devices for the doors of gas-retorts." Oct. 20.

20,066.—PRICE, W. E., "Carburetting coal gas or other gaseous fluid." Oct. 20.

20,080.—STIENS, P., "Appliances for obtaining light." Oct. 20.

20,093.—REDFERN, G. F., "Incandescence gas-burners." A communication from the Compagnie Parisienne du Bec Deselles-Gillet. Oct. 20.

20,123.—SHILLITO, T. R., "Gas and petroleum motor." A communication from the Leipziger Dampfmaschinen und Motoren Fabrik. Oct. 22.

20,202.—ENTWISLE, J., "Gas-purifiers for furnaces." A communication from W. L. Wallis. Oct. 23.

20,253.—TENNANT, P. C., and HALL, J. E., "Apparatus for regulating or controlling the supply of fluids, chiefly designed for use in connection with carburetting or enriching gas." Oct. 23.

20,399.—BENNETT, A., "Gas-burners." Oct. 25.

20,653.—ROBINSON, H. and A. E., "Gas or combustible vapour engines." Oct. 29.

20,676.—MOORE, F., "Gas-meters." Oct. 29.

20,735.—TIEGS, O., "Manufacturing bodies which are to be raised to incandescence." Oct. 30.

20,746.—VILLIERS-STEAD, F., "Electrical prepayment gas-meter." Oct. 30.

20,752.—PROCTOR, J., "Supplying coal to the hoppers of mechanical stokers." Oct. 30.

20,753.—HALL, S., H., and L., "Mechanical stokers." Oct. 30.

20,866.—ATKINS, J., "Flues and chimneys of gas-stoves and gas-fires." Oct. 30.

20,941.—RITCHIE, W., "Gas-carburetting apparatus." Nov. 1.

20,989.—HICKS, H. A., "Gas-meters." Nov. 1.

20,998.—MORRISON, J., and BOOTH, T., "Producing and saving gas." Nov. 2.

21,013.—HOWARTH, J., "Gas economizers and purifiers." Nov. 2.

21,032.—DUKE, J. F., "Automatically lighting gas." Nov. 2.

21,051.—RUSCOE, J., "Charging gas-retorts." Nov. 2.

21,079.—HECKERT, G., "Devices for lighting gas-lamps and the like." Nov. 2.

21,108.—COWAN, W. and W. H., "Prepayment gas-meters." Nov. 3.

Little and Graham, Limited.—A company has been registered under the above title, with a capital of £10,000, in £1 shares, to carry on business as gas and mechanical engineers, boiler makers, iron and brass founders, &c. The first Directors, of whom there are to be not less than two nor more than five, are to have a qualification of £50; subsequent ones, £250.

Accident at the Worcester Gas-Works.—Last Tuesday an accident occurred to James Cleaver and James Cole at the Worcester Gas-Works. They were employed riveting the new gasholder which is being erected by the Gas Company, when a plank on which they were standing broke, and they fell a distance of nearly 30 feet to the ground. Cleaver had two bones broken in his left wrist, and his back was injured; and Cole had a severe sprain also of the left wrist, and sustained a slight concussion of the brain.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Combinations of Traders in Gas-Works Materials.

SIR,—It is time the gas industry declared that it is not to be dominated by "rings" and combinations of traders, and that steps were taken to ensure their defeat. The tube makers combined some time ago, then the meter makers, and now the gasholder builders; and it seems the farther the system extends the more unfair and overbearing it becomes. Even if these combinations could act fairly, the inevitable effect is to stereotype prices, to paralyze enterprise and invention, by removing all inducement to cheapen and improve the processes of manufacture, and to deprive the gas companies of all the advantage they ought to obtain from the reduction in the price of the various metals, the introduction and improvement of machinery, &c. For instance, iron, tin, lead, and copper have all fallen in price (some of them enormously) of late years, of which the entire advantage is taken by the manufacturers.

I admit that severe competition is not an unmixed good—that it does, in some cases, result in hardship; but it certainly furnishes the most necessary and only stimulus to improvement. Without it, all improvement must cease; and this being so, its removal would result in infinitely greater evil than its continuance, even in intense form.

The tube makers have, by their combination, simply stopped reductions in the price of tubes. The meter makers have retained for themselves the advantage they derive from the reduced prices of tin and tin plates, lead, and copper, and improved methods of working; for the price of meters has not been reduced for very many years, but has been in some particulars indirectly increased, as in the reduction of the guarantee from five years to one year in the case of the automatic meters, while the price of station meters has been actually and largely increased. Two or three months ago, the South Metropolitan Company asked for tenders for a station meter. Three firms tendered, all at the same price—£550, which was about £130 more than it would have been before the combination was formed. We declined all the tenders, and said we would make the meter ourselves. This alarmed some of the makers; and the traveller of one of them saw me, and said they had arranged that, so far as station meters for this Company were concerned, there should be no combination; and they offered to do the work for £430. After a little hesitation as to whether or not we should persist in our intention to make the meter ourselves, this offer was accepted. The idea is, however, by no means abandoned, and I fully expect that next year the Directors will equip a complete meter factory; and I would suggest that Mr. Broadberry's ominous hint, given yesterday at the meeting of the Southern District Association, to start a co-operative meter manufactory, should be adopted by a combination of gas companies. This could be done on the same plan as the co-operative societies have adopted in the flour-mills and the co-operative wholesale associations of both England and Scotland, which have been most successful in supplying the distributive co-operative societies with nearly all the goods they require.

If what I hear is true, the worst case, for which the term "dishonesty" would not be too strong, is that of the combination of certain gasholder builders. I have been told—and the information has been corroborated—that the *modus operandi* is as follows: A gasholder is wanted, and tenders are invited. The members of the combination in the first place make their estimates, and send them to their Secretary (for the combination, I hear, has a Secretary). The lowest is to have the work, or rather it is agreed that his shall be the lowest tender; but it is not to correspond with the amount of his private estimate. An addition is made, and the tender he sends in is his original estimate *plus* the addition ordered or arranged by the combination. But, having thus enabled one of their number to obtain a considerably higher price than that at which he estimated he could do the work, they do not leave him in full enjoyment of this addition, but require him to share it with his colleagues—I was going to say fellow-conspirators—in the transaction. I was credibly informed that, in one recent case, as much as £3000 was thus added; and supposing there were six tenders, there was booty amounting to £500 apiece for them. I am really unwilling to believe that men whom I have regarded as honest and honourable traders can have descended so low as to adopt the tactics of the "knock-out" of the common brokers at a sale of furniture by auction. However, these things are said, and said by such men and in such a way as to make it difficult to disbelieve them; and it is not to the interest of honest traders that, if untrue, they should gain currency, as they certainly will if unproved.

There can, I fear, be no doubt that the members of the various trades are combining to keep up, and it seems to increase, prices at a time when, by the reduced cost of raw materials and the development of the use of machinery, prices ought to come down. The gas companies, however, are quite able to protect themselves by manufacturing on their own premises many of the articles they require, and by combining, in the manner suggested by Mr. Broadberry, to produce others that may be considered rather beyond their compass. The larger companies—say, those using upwards of 100,000 tons of coal a year—can do almost everything, even to the erection of gasholders; and it would not surprise me if a capable and earnest engineer of a much smaller concern were to successfully build his holders. I am sure it could be done. I should much like to try it, and to see it tried; for there is no reason why gas companies should not follow the example of the railway companies in these matters.

Reigate, Nov. 9, 1894. GEORGE LIVESEY.

Compressed Gas v. Gasholders.

SIR,—Referring to the editorial remarks on "Portable Gas" in your issue of the 23rd ult., I notice that your correspondent "Anglo-Dane" is desirous that the question of compressed gas should be discussed further in your columns. I may say that I should also be glad of some information relative to the subject.

The success of lighting railway carriages with gas of rich quality

suggests some points for consideration with regard to gas of 15 or 16 candle power. Could not the system of compressed gas be adopted in conjunction with the existing holders in small or medium-sized works where additional storeage is required? The question of large works is, I think, best left out. If not applicable, what are the objections to, or the difficulties of the system?

By way of illustration, take the case of a small town where the gas consumption does not increase very rapidly, or where the increase has been more in the day than in the night consumption, and where, for all ordinary requirements, the holders are sufficient in capacity. On certain days in the week—for instance, a market day or a Saturday—for three months in the winter it is known that there may be a bit of a pinch. The day preceding this is an early closing day, when shops are shut, and the consumption of gas is much less than on other week days; and, as a consequence, the holders are full early on the following day, and some of the retorts are left uncharged. The quantity of gas which could be made on this slack day, and stored, would relieve the manager of all anxiety for the market or Saturday night.

It is assumed a steam or gas engine, a pump, and a receiver would be required; the latter being provided with a pressure-gauge and a suitable pressure-reducing valve. The gas would be pumped from the holders, a little before they were full, into the receiver, and allowed to pass back again into them as required. When once the air had been expelled from the receiver, the latter would remain constantly charged with gas at the ordinary pressure of the holders, when not required under compression; and this would obviate the inconvenience and possible danger of expelling the air a second time. The receiver could not, it is thought, be of better design than the ordinary egg-ended boiler of suitable strength. In the hypothetical cases referred to, the holders are single-lift ones. Telescoping these holders would affect the working of the governors and the pressure on the district. The governors act well with single-lift holders; but they would not be suitable for varying inlet pressures with double-lift ones.

Will those of your readers who have carried out experiments in compressing 15 or 16 candle gas kindly give the results? Does the quality suffer much? In your remarks on the 23rd ult., it is stated that gas has been compressed to 11 atmospheres. The advantage of storing gas in this small space would be a boon, if it could be done with ease. It would be interesting, no doubt, to many of your readers, to have some reliable information as to whether 15 or 16 candle gas can be compressed with anything approaching the facility with which 40 to 50 candle gas is now compressed and supplied in portable form.

Nov. 1, 1894. INQUIRER.

Illuminating Power and Lighting Effect.

SIR,—I am a humble consumer of coal gas, and, as such, not only do I take an interest in the continued perambulations of my gas-meter, but also endeavour to obtain as much lighting effect as possible from my burners, which are, I might add, of the ordinary batswing type. As I read up the subject a little, my attention has been called to the views which have been propounded by Mr. T. Newbigging on the interesting question of "Illuminating Power and Illuminating Effect." The bad-burner question seems to throw a certain amount of light on the matter in a very modest and wholly unintentional manner; because, no matter how rich the gas, or how high the illuminating power, a bad or unsuitable burner refuses to give the desired illuminating effect.

I think a system might be devised whereby the lighting effect of a gas-burner could be measured as well as the intensity only, as in the present-day system of photometry. The consumer, when he pays for his illumination, expects to have a certain amount of illuminating effect for his money; and it matters not to him whether the gas is of 14 or 20 candle power. But to a gas manager it must be a very disappointing fact that, while his consumers get good illuminating effect with his gas, which, with a very scientific look on his face, he reports to his committee as being of 18-candle power, a brother manager at a neighbouring works is turning out a gas of 14-candle power which gives a very much better lighting effect.

Gas engineers at the present time seem to be more concerned with inclined retorts and processes for enriching than with the more important problem of the complete purification of coal gas. Absence of carbonic acid in the gas as delivered to the consumer is an absolute necessity if illuminating effect, *not* power, is required.

Now as to the use of the photometer in gauging the illuminating value of gas. I cannot understand why Argand burners should be used as the standard, when they are so little employed for lighting purposes. Then, again, why test the gas photometrically under conditions totally opposite to those under which the gas is burnt? Supposing a 14-candle gas to be under test, the black walls of the photometer-room deteriorate the result very much; while, to obtain a photometrical reading of 15 candles, gas of 18 to 20 actual candle power has to be tested. The difference—*i.e.*, the illuminating effect—is entirely lost. A 14-candle gas, when properly purified, has to thank the light colours and surroundings of a room for producing an illuminating effect equal to 18-candle power.

I am sorry for monopolizing so much of your space, but I have a desire to see this subject more freely discussed; and I trust some of the leading members of the gas engineering profession will search into the matter more fully, for it will bear it. I can assure you that I have seen results and illuminating effect obtained from a gas of no more than 14-candle power which are truly astounding; and this without the slightest enrichment, or the aid of incandescent mantles.

Nov. 7, 1894. A MODEST GAS CONSUMER.

The New Water-Works at Sandwich.—On the 30th ult., the Mayor and Corporation of Sandwich assembled at the pumping-station at Woodnesborough, and took over the water-works from the contractor. The boilers, engines, and pumps are in duplicate; the pumps being capable of delivering 15,000 gallons of water per hour to the reservoir on Beacon Hill. The works have been designed and superintended during construction by Messrs. Easton, Anderson, and Goolden.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Monday, Oct. 29.

(*Before the* LORD CHANCELLOR *and Lords Justices* LINDLEY *and* SMITH.)

The Mayor and Corporation of Bradford v. Pickles.—Interference with a Source of Water Supply by Quarrying.

This was an appeal by the defendant from the decision given by Mr. Justice North in May last, whereby he granted an injunction restraining Mr. Pickles from doing certain things which the plaintiffs claimed interfered with their water supply.

Mr. EVERITT, Q.C., and Mr. TINDAL ATKINSON, Q.C., appeared for the appellant; Mr. COZENS HARDY, Q.C., and Mr. B. EYRE represented the respondents.

The facts of the case were stated in the JOURNAL for May 29 last; but the main points may be briefly repeated. By a Private Act of Parliament, of 1842, the Bradford Water Company was formed; and they purchased certain lands known as the Trooper or Manywells Farm, upon which were springs and streams. The Company were authorized to take and divert for their purposes the waters of Manywells; and the Act provided expressly that, after the purchase of the property, it should not be lawful for any other persons than the Company to divert, alter, or appropriate "in any other manner than by law they might be legally entitled" any waters then supplying or flowing from the same, or to sink any well or pit. The Bradford Corporation took over the rights of the Company in 1854; the sum paid for the purchase being £215,085. The provisions of the Corporation Act of that year were almost identical with those of the Act of 1842, and practically incorporated them. There were two other Acts which bore on the matter afterwards, the Bradford Water-Works and Improvement Act of 1868, which in section 21 provided that any person who should pollute the water supply of the Corporation or interfere with its water conduits should be liable to certain penalties; and the Bradford Improvement Act of 1873, which had provisions to the same effect. The works were erected at Manywells; and since that time the water had been used from there. On Dec. 5, 1891, defendant gave notice to the plaintiffs that, at the end of thirty days, he intended to work the mines and minerals underneath certain land, of which he claimed to be the owner, near to the Trooper Farm, by sinking certain pits. He intimated that he sent this notice as a matter of courtesy, and not in recognition of any rights on the plaintiffs' part. A plan accompanying the notice showed that the defendant contemplated a drain running from the stream called Hewenden Beck, along the north side of the farm, and in defendant's land, to a pit in Doll Lane near the north-west corner of the farm; and thence he contemplated making a tunnel 3 feet by 3 feet running under Doll Lane for some distance. This tunnel would have been 20 feet below the level at which the spring water issued from the surface. There was a fault in the strata existing, which held and collected large quantities of water, and caused it to issue here. The plaintiffs believed that the defendant's object was to pierce through this fault; and by this means cause the water to flow off by the tunnel, and either be lost to the plaintiffs or be polluted. The plaintiffs accordingly gave notice to the defendant not to proceed with his works. This, however, he did, with the result that the water became disturbed and polluted (though the defendant denied that this was the case); and the present action was commenced. The plaintiffs alleged that what defendant did was not a necessary or proper way to work the stones or minerals, and that his object was to compel the Corporation to purchase his land or pay him for stopping the works. Mr. Justice North issued the injunction; and since then the defendant had not continued the work, pending the result of the present appeal.

Mr. EVERITT now argued that the words of the sections referred to did not apply to the present case at all. What they were intended to cover was the action of persons acting illegally. If the water referred to were surface water running in a defined channel, of course that could not be interfered with; but this was not surface water. He pointed out that there was no provision made for paying compensation to anyone in the position of defendant; and he suggested that there would be, on that ground, *primâ facie* presumption that there was no intention of taking away any pre-existing private rights. The Corporation had not bought any such rights; they had only bought the springs rising in the lands—in fact, they simply purchased the farm, and acquired the springs as part of the property. Penalties were mentioned in the section along with the right to recover damages. This fact, he contended, was the key to the whole thing. It was evident that the penalties were simply put in to strengthen the existing position. The people dealt with were those who did illegal acts, and penalties were imposed not on acts which now became illegal, but which were already illegal. Undoubtedly the section was ambiguously worded.

Lord Justice LINDLEY pointed out that water supplying the springs was different from the water of the spring. Until the water issued from the ground, he questioned if it were a spring.

Mr. EVERITT said that the whole matter turned largely upon the meaning of the words. The words used were "now supplying the springs;" but what supplied the springs was the percolating water.

Mr. TINDAL ATKINSON followed, and argued that, if the construction of sections 234 or 49 of the Act suggested by the other side were the true one, the result would be that his client would be put in a position in which no other landowner had ever been placed. In the Water-Works Clauses Act, there were sections for the purpose of giving full compensation to riparian owners where water was taken for public purposes. The first result of this construction would be to deprive the defendant of valuable advantages. On the hillside in question, it was contended by the Corporation that there was a sort of sponge containing the water that bubbled out on both sides. The result of what they asked would be to deprive his client of the right to dig down and intercept the water that percolated through on his side. What his client had intended doing was not making a well or shaft; but his object at the time when he was stopped from his works by the injunction was to make a drift. The shaft was merely incidental to the

drift; and the latter was intended to drain away from all land belonging to the defendant. The first part of one of the sections allowed them to make a drift. It was conceded that they had the right to deal with underground water, therefore they had a right to deal with it by the drift. But his friends on the other side relied upon the second part of the section. Here were two parts of one section that contradicted each other.

Tuesday, Oct. 30.

The case for the respondents was opened this morning by

Mr. COZENS HARDY, who submitted that the learned Judge in the Court below was quite right; that the section was rightly interpreted; that what the defendant was doing was contrary to law: and that the respondents were entitled to judgment. Whatever might be the rights of a landowner in respect of underground water, he urged he had no right to take such water away maliciously. From the evidence given before Mr. Justice North, it appeared that there was a natural conduit to the mouth of the spring; and the evidence was clear that, when the defendant carried on his works, the water in this conduit became discoloured. The water came along its conduit in a solid and regular volume; and he asked their Lordships to hold that water so coming in a well-defined solid body must necessarily be water passing along a well-defined channel under the spot where the defendant was making a shaft.

The LORD CHANCELLOR asked why they were to suppose that the Legislature would take away rights from any person without compensation? It would be contrary to the custom of Parliament.

Mr. COZENS HARDY observed that the Company's Act was passed in 1842, when the rights of sub-riparian owners were not perhaps properly understood. In the meantime the Water-Works Clauses Act had been passed, and had been included in the Act of 1854. At that time the Manywells Springs contributed the sole supply for Bradford. In section 8 of the Act, there was an express reservation of the rights of parties. Could it have been contemplated that the whole water supply of Bradford should ever be at the mercy of Mr. Pickles?

The LORD CHANCELLOR asked why Mr. Pickles should be compelled to give up any of his rights.

Mr. COZENS HARDY pointed out that the judgment agreed that the object of the defendant was to injure the plaintiffs. The learned Judge came to the conclusion that the defendant had been going on with the works with the idea of getting the Corporation to pay him compensation.

Lord Justice SMITH inquired if the Corporation were willing to buy the defendant's property at a fair price.

Mr. COZENS HARDY said he had not been instructed to answer that question.

Mr. EVERITT said that the defendant was quite willing to sell.

The LORD CHANCELLOR pointed out that, if the defendant had collected water which he had a legal right to take, for the purpose of selling it to the plaintiffs, what would they say?

Mr. COZENS HARDY said that he would have a right to do that. But the case was different. He was not taking the water; but he was simply spoiling it for the plaintiffs. And if he went on and pierced the fault in which the water lodged and collected at present, the water would be lost to Bradford for ever.

Mr. EYRE, who followed, stated that Mr. Pickles' predecessor in title had notice when the Corporation were seeking to obtain their Private Act of Parliament; and, if he had chosen, he could then have raised his objection to it.

Mr. EVERITT, in replying, said that the motive of the defendant had nothing to do with the question. Even if that motive were morally unworthy, it could not affect his legal right. In his evidence, defendant had stated that he believed that the stone on his property was valuable. He had consulted an expert, who had advised him to make a drift to drain the land.

Their Lordships reserved their decision.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Wednesday, Oct. 31.

(*Before Mr. Justice* ROMER.)

East Stonehouse Local Board v. Victoria Brewing Company.

This was an action for an injunction to restrain the defendants from permitting a cesspit in a field adjoining the brewery to remain connected with the brewery, and from using the cesspit so as to pollute the water coming into the reservoir of the plaintiffs.

Mr. JOSEPH WALTON, Q.C., and Mr. YOUNGER appeared for the plaintiffs; Mr. NEVILLE, Q.C., and Mr. MANBY, for the defendants.

In 1874, the plaintiffs, the Urban Sanitary Authority, acquired the undertaking of the East Stonehouse Water-Works Company, which included two reservoirs of unequal size, situate outside the district of the Local Board at Pennycross, in the county of Devon. The defendants are a Brewery Company carrying on business at Nutley, in the same county; the brewery being situate to the east of the reservoir. In August, 1893, complaints were received by the Local Board from the inhabitants of the district, with reference to the quality of the water with which they were being supplied; and in consequence of these complaints, the Local Board caused a careful examination of the water in the reservoir to be made. It was then found that the water was so contaminated as to be unfit for drinking purposes, and dangerous to health. It also appeared, on further investigation, that the contamination was being caused by the overflow from the defendants' cesspit, which the defendants were then causing or permitting to enter and pass down a rubble drain into a culvert forming one of the intakes of the smaller reservoir. The water in this reservoir had to be thrown away; and some 5 million gallons purchased from the Plymouth Corporation. Subsequently, the defendants entirely disconnected their brewery from the cesspit, and provided another outfall for sewage and refuse from the brewery; but before this was done, the Local Board had suffered damage to the amount of £200, which they now sought to recover.

By the defence, it appeared that the reservoirs are situate at the bottom of a valley or basin, and are supplied chiefly by the surface water which flows from the rising ground lying to the north-east and south-east; there being no intercepting drain, or anything to prevent any water or sewage from flowing directly from such rising ground into the reservoir. The supply of water depends upon the character of the season; and, after a period of drought, the plaintiffs have to supply their district with water purchased from the Plymouth Corporation, with which the latter are bound by Act of Parliament to supply them. The defendants denied that their cesspit was the cause of pollution; and they alleged that the water had for a long time, and before the brewery commenced operations, been notoriously impure. On this ground, in the early part of 1893, the plaintiffs promoted a Bill in Parliament for the purpose of obtaining a better supply of water, which was opposed by the Plymouth authorities.

It being admitted that the defendants had so altered their works as not now to occasion any nuisance, an injunction was not pressed for; the plaintiffs seeking to recover the cost to which they had been put in obtaining a supply from the Plymouth authorities, and also the costs of the action. At the outset, his Lordship suggested that the parties should pay their own costs. To this, the defendants assented; but, the plaintiffs objecting, the action was partially tried out. Several members of the Local Board and the Water-Works Engineer were called and gave evidence. During the examination of the Engineer, his Lordship said he thought the parties might very well save time and expense by settling, upon the terms of the plaintiffs receiving £83 by way of damages, and the costs of the action; the defendants to receive the costs of the motion for an injunction. After a short consultation, the parties accepted these terms; and an order to the effect was accordingly made.

COURT OF SESSION—BILL CHAMBER.—Tuesday, Nov. 6.

(*Before Lord* LOW.)

The Corporation of Falkirk v. the Falkirk Joint-Stock Gas Company and Others—The Appointment of an Oversman.

To-day Counsel were further heard in the application by the Corporation of Falkirk against the Falkirk Joint-Stock Gas Company, Mr. J. Barr, C.E., of Glasgow, and Messrs. Corbet Woodall and E. Herbert Stevenson, of London, in which it was sought to interdict the respondents from proceeding with the arbitration to determine the price the Corporation are to pay for the undertaking of the Company, with Mr. Barr as Oversman. As stated in our Scotch Correspondent's "Notes" in the last two numbers of the JOURNAL, Messrs. Woodall and Stevenson are the Arbiters in the reference; and they appointed Mr. Barr to be Oversman. The Corporation of Falkirk objected, on the ground that they had consulted Mr. Barr upon their case last July.

Mr. URE and Mr. WILSON appeared for the Corporation; Mr. COMRIE THOMSON and Mr. CRABB WATT, for the Gas Company; and Mr. DICKSON and Mr. G. WATT represented Mr. Barr.

It was stated, on behalf of Mr. Barr, that, although he had been asked to be a witness for the Corporation, he had not done anything in the way of advising them. He had a short interview with their legal adviser on the 13th of July last; but nothing material passed on that occasion.

Thursday, Nov. 8.

To-day the case was disposed of.

Lord LOW said the complainers (the Corporation) did not dispute that, assuming their averments were relevant to infer disqualification on Mr. Barr's part, they must reduce his nomination, and that the complainers' application could only be used for the purpose of staying proceedings in the submission until the action for reduction was disposed of. The complainers' averment, as originally framed, in regard to the circumstances alleged to disqualify Mr. Barr were very meagre; and as Mr. Ure, in addressing him in support of the note, made a much fuller statement, he allowed the complainers an opportunity to amend their record to the effect of setting forth fully and specifically the grounds upon which they maintained that Mr. Barr was disqualified. This had now been done; and he might assume that the averments now made were those upon which, if the note were passed, the complainers would seek reduction of the nomination. In these circumstances, he thought the question was whether the complainers' averments, if established, would entitle them to have the nomination set aside. There was no doubt that complete impartiality was essential to the discharge of the office of Oversman, and that if the person nominated had previously stood in a relationship either to the parties or to the subject-matter of the reference, the plain, practical tendency of it would be to create a bias in the mind of an ordinary man, and he would be disqualified. The subject-matter in the submission in this case was the fixing of the price to be paid by the complainers for the undertaking of the Falkirk Gas Company, which they were bound to take over in terms of an Act of Parliament. Each of the parties appointed an Arbiter, and the Arbiters appointed Mr. Barr to be Oversman. Apart from the relationship which had previously existed between Mr. Barr and the complainers, it was admitted that he was in every way fitted for the post; but the complainers said that he could not deal with the question with an open and unbiassed mind, because he had previously been consulted by, and had advised, them in regard to the conduct of their case. The complainers' averments, as amended, amounted to this—that they had a meeting with him, and that at this meeting they disclosed to Mr. Barr their views as to the way in which the claim of the Company should be met, and that they obtained his opinion as to the lines upon which their case should be conducted, and as to the witnesses who should be examined. Assuming these averments to be true, the question was whether what passed between the complainers and Mr. Barr was calculated to render him a partial judge, or to prevent him giving a fair and unbiassed award as to the price to be paid for the undertaking. In his (his Lordship's) opinion, this question must be answered in the negative. If the objection had come from the Company, there would have been more force in it; but even if this had been the case, he should have thought the mere fact of the complainers having had a consultation with Mr. Barr as a man of skill whose services they desired to obtain, at which they

expressed the views they then held with regard to the best line they wished to take, and heard the views of Mr. Barr on the same subject, was insufficient to warrant the inference that his judgment was likely to be prejudiced or biassed so as to disable him from giving a fair and impartial award. He did not think it was enough for the complainers to say there was a probability that the meeting which they had with Mr. Barr might have led him to prejudge the question. He was of opinion that, to disqualify an Oversman, the circumstances must be such that the Court was able to say that the plain, practical tendency would be to bias the mind of the Oversman in favour of one of the parties. He did not think any such circumstances had arisen there. Assuming the complainers' averments to be absolutely true, he could not see how they could justify the inference that Mr. Barr's mind was likely to be biassed in favour of the Company, or that there was a practical danger that his mind was so biassed. If the complainers had said that, when consulting Mr. Barr as their skilled adviser, they had confided to him certain matters which, although they would not be put before the Arbiters and Oversman in the course of the submission, were calculated to prejudice the mind of anyone knowing them against the complainers, the case might have been different; but there was no suggestion, in the averments, of any such thing having taken place. He should therefore refuse the note.

Mr. COMRIE THOMSON asked for expenses.

Mr. DICKSON, on behalf of Mr. Barr, said he did not think that it was becoming on his part to ask for expenses.

Lord LOW said he would find the Company entitled to their expenses. He thought it was worth Mr. Barr's while considering whether he should go on as Oversman.

Bolton Water Supply.—The Thirlmere water scheme of the Manchester Corporation seriously affects the revenue of the Bolton Water Department. The latter is deprived by it of the custom of the Leigh and Hindley Local Boards, which means an annual loss of £3743 on water revenue; and as the Lancashire and Yorkshire Railway Company have sunk a well at Lostock, there is a prospect of a still further diminution in income of the Bolton Corporation from water. While the Water Committee of the Corporation have this decreased income to face, they have the satisfaction of knowing that there will be no need to proceed with certain proposed new works, including the construction of another reservoir, for some time at any rate.

Gas Exhibition in Chester.—An exhibition of gas appliances was held from Tuesday to Friday last week in the Chester Music Hall, under the auspices of the Chester United Gas Company. The stove exhibits were furnished by Messrs. Fletcher, Russell, and Co., Messrs. Richmond and Co., and Messrs. John Wright and Co.; and meters, fittings, and burners were shown by various makers. Penny-in-the-slot meters and incandescent gas-lights were much in evidence. We can only to-day briefly notice the exhibition, which was opened by the retiring Mayor (Alderman L. Gilbert), and was largely attended. The arrangements, which included lectures and cookery demonstrations, by Mrs. Page, and a lecture on "Coal Gas and its Uses for Domestic Purposes," by Mr. T. E. Pye, of Shrewsbury, were carried out by the Company's Engineer and Manager (Mr. R. Hunter).

The Dangers of Electric Currents.—The danger arising from the conveyance of powerful electric currents under the public thoroughfares was further exemplified last Saturday afternoon, just opposite Cannon Street Station. It appears that a man named George Clark was driving a one-horse brougham along Cannon Street, when the horse suddenly fell down shaking violently. The coachman, thinking the animal was ill, jumped down with the intention of unharnessing it, and he was immediately followed by his companion, who had been riding with him on the box. A warehouseman also ran to their assistance; but they were unable to do anything, as they all experienced severe electric shocks, to avoid which they had to seek the safety of the pavement. In the meantime, the body of the horse was being shaken to and fro on the roadway; it was foaming at the mouth, and blood was issuing from its nostrils. In three or four minutes it was dead. A crowd soon congregated about the spot; and several persons who ventured too near received shocks which caused them to fall to the ground. Three men had to be taken to St. Bartholomew's Hospital. Within a few minutes of the horse's death, two explosions took place; and two of the box-covers of the electric light mains were forced out of their sockets. The police were soon on the spot, and kept the crowd back while labourers fenced off the pavement and the box-cover. Engineers quickly arrived and started at once searching for the leak. The explosion was no doubt due to an accumulation of gas in one of the electric light conduits, and to its ignition by an electric spark.

The Price of Gas at Birmingham.—At the annual meeting of the Birmingham City Council last Friday, Mr. Kimberley, in accordance with notice, moved—"That as it seems probable that contracts for coal can be placed at the old prices, the Gas Committee be instructed to consider and report to this Council the advisability of lowering the price of gas." In support of the motion, he said that, if the Gas Committee could see their way to reduce the price, it would be greatly appreciated by the consumers and tradesmen, who were feeling the effects of the depression in trade. He thought that as nearly a year had elapsed since the coal strike, and the colliers were working at a 10 per cent. reduction in wages, contractors should be able to supply coal at the old prices, and the extra 3d. per 1000 cubic feet charged for gas should be taken off. Mr. Reynolds seconded the motion, and referred to the lower price of gas which was being charged by some of the Metropolitan Gas Companies. Alderman Pollack reminded the mover and seconder of the resolution that the coal contracts were made in June for the succeeding year; and there were therefore eight months before any change in coal prices was likely to be experienced. He had, however, already publicly stated that the Gas Committee would present a report in December, and that the question of a reduction in the price of gas would be one of the subjects dealt with. It was thus not necessary to admonish the Committee to consider the subject. Mr. Johnson suggested that, in view of Alderman Pollack's statement, the resolution might be withdrawn. Mr. Kimberley accepted the suggestion.

MISCELLANEOUS NEWS.

IMPERIAL CONTINENTAL GAS ASSOCIATION.

The Half-Yearly Ordinary General Meeting of this Association was held last Tuesday, at the Cannon Street Hotel—Sir JULIAN GOLDSMID, Bart., M.P., in the chair.

The SECRETARY (Mr. R. S. Gardiner) read the notice calling the meeting, and subsequently the following report of the Directors:—

The present half-yearly ordinary general meeting of the proprietors has been convened, in conformity with the Association's Acts of Parliament, for the purpose of receiving a report from the Directors upon the affairs of the Company, and of declaring a dividend for the half year ended the 30th of June last.

The following summary shows the results of the Association's operations during that period: The quantity of gas made in the half year ended the 30th of June last was 4196 million cubic feet; the quantity made in the corresponding half year of 1893 was 4145 million cubic feet—being an increase of 51 million cubic feet, or at the rate of 1¼ per cent. The total number of lights on the 30th of June last amounted to 2,172,428; there being at that date 153,329 consumers on the books of the Association. At the close of the corresponding half year of 1893 the number of lights was 2,072,945, which gives an increase of 99,483, or at the rate of 4·8 per cent. The entire length of mains on the 30th of June last was 1763 miles; the length of mains laid on the 30th of June, 1893, was 1692 miles—an increase of 71 miles.

The Directors have pleasure in reporting that the gas-rental for the half year under review exhibits a fair improvement; and it is accompanied by a moderate addition to the profit, notwithstanding that the benefit derived from the decreased price of coal and from the increased value of ammoniacal liquor was almost nullified by the decrease in the value of both coke and tar.

The plant and mains at all the stations were maintained in a due state of efficiency.

The Directors have sold land for which there was no further use at Amsterdam, Rotterdam, and Toulouse, and have purchased land to provide for future extensions at Cholet and Corbeil.

The Directors beg to report that they have secured a concession for the supply of gas to Ricklingen, a suburban commune of Hanover.

As mentioned by the Chairman at the last meeting of the proprietors, the Directors had, in the course of the half year under review, to deal with a strike of stokers and yardmen at Vienna. The energetic steps taken by the officers of that station to meet the difficulty, were entirely successful. The Directors cordially supported them, and are glad to add that no interruption took place in the public lighting, and the stipulations and obligations of the contract were carefully fulfilled.

The additions to the producing power of the Berchem works at Antwerp are making good progress; and the erection of a new tank and gasholder is being proceeded with to provide additional storeage accommodation.

The Directors desire, in conclusion, to draw the attention of the proprietors to the accounts for the half year ended the 30th of June last. These have been duly audited; and from them the Directors have, in accordance with the provisions of the Companies' Clauses Consolidation Act, prepared a scheme, showing the profit of the Association for the half year, and the portion thereof applicable to the purposes of dividend, which they recommend now to be declared—viz., a dividend of 5 per cent. for the half year ended the 30th of June last, and a bonus of 1 per cent., both payable free of income-tax on and after the 1st day of December next.

The CHAIRMAN, in moving the adoption of the report, remarked that, although they had had difficulties and troubles in the course of the half year, nothing unusual had occurred in the proceedings of the Association to which he could call attention. Every year, in his opinion, the responsibilities of the Directors increased rather than diminished. All kinds of questions arose, which they had to settle to the best of their judgment in the interests of the Association; but at the same time these were not questions which could be brought before a general meeting of the shareholders, or upon which any statement could be made in the Directors' report. His colleagues and he himself were all ready to devote their time and the best of their ability to promoting the welfare of the Association. It would have been noticed from the report which had been read to the proprietors that they had had a somewhat improved condition of things, in that the price of coal had been low; and although they had received a reduced price for some of their residuals, they had obtained for others an increased amount. On the whole, he thought, from the experience he had gained, that low prices all round were the best for a gas company, for they tended, he believed, to increase the consumption, especially when stimulated to a certain extent by the competition of the electric light. There was no doubt that in some of their towns the electric light had made some inroad on the consumption; but in others, where the circumstances of the localities did not so largely conduce to the progress of the electric light, competition had not arisen up to the present. He had expressed his belief before that the future of the electric light was in connection with large and expensive installations for private houses, or for outside work in places where gas did not apply; but so far as gas was concerned, it would still be employed in poorer houses and in richer houses, too, for the purposes for which it could be used, and certainly throughout the towns in all parts of the world there would always be a considerable consumption of gas. Therefore, although at one time some persons feared that gas would be superseded by the electric light, in his opinion that would not occur, as there was a proper sphere of work for both these two great illuminants. As far as their own business was concerned, the shareholders would see that, in addition to recording a moderate increase of consumption and of profit, they had one or two other sources of gratification. For instance, 4 per cent. debentures amounting to £123,600 fell due in the course of the year; and according to the resolution passed at a previous meeting of the Association, they issued 3½ per cent. debenture stock, which was, if he might say so, greedily taken up by the proprietors of the debentures. This financial operation, therefore, had been eminently successful. In other respects, they had no reason to complain, because the popularity of the Association among its consumers had, he thought, increased rather than diminished. While speaking on the subject of finance, he might state that the Directors had noticed that in many Companies which were as prosperous as their own, and where there was a considerable capital, the Auditors received a larger rate of remuneration than that which had hitherto been given to the Auditors

of the Association. They found that the usual fee for Auditors of Companies of such importance as their own was 100 guineas each, which, in the opinion of the Directors, would not be too much to allow their own Auditors, instead of 50 guineas each, as at present. In addition to examining the accounts, the Auditors had other duties to discharge—such as signing papers for income-tax, and returns which had to be made on the Continent. The Directors thought that the Auditors' remuneration ought to be more or less in proportion to the amount of work done by them; and therefore, although it was not the business of Directors to vote the Auditors' fees, but of the shareholders, he advised the latter to raise the fee of the Auditors as he had suggested. If so, it would be a total charge of 200 guineas a year on the finances of the Association, instead of the 100 guineas as at present. He regretted to state that, on the 24th of August, they lost one of their ablest Engineers, M. de Vigne, who was chief of their station at Lille, and who had rendered them important services for many years. He was devoted to the interests of the shareholders, for whom he did admirable work. They had also lost another good servant, who died earlier in the year; he referred to their Chief Accountant at Vienna, Mr. Dudeum, who was known to all the older Directors as one of their most devoted servants and best accountants. He did not know that there was anything further for him to say. There were difficulties for them to meet; and they must meet them as they arose. Their main difficulties were those connected with the renewal of contracts; but these were matters which could not be discussed publicly at any meeting. They did their best to overcome such difficulties when they occurred; and they took the greatest possible interest in the affairs of the Association, the prosperity of which they would do all in their power to maintain.

Mr. T. H. G. NEWTON seconded the motion.

Mr. FARRE asked whether the Chairman was prepared to contradict a Stock Exchange rumour which had been repeated several times this year, to the effect that the renewal of the Vienna contract had been definitely refused.

The CHAIRMAN replied that he had not heard of this interesting rumour; nor was he in the way of hearing the many reports which he was told arose on the Stock Exchange from time to time, or from day to day. As a matter of fact, nothing of the sort had occurred. They had been more or less in negotiation with the Vienna Municipality, and they were still; but he had nothing fresh to communicate to the proprietors.

He then put the motion, which was unanimously adopted.

The CHAIRMAN next proposed the declaration of a dividend of 5 per cent. for the half year ended June 30, and a bonus of 1 per cent. on £3,800,000 stock of the Association, payable, free of income-tax, on and after the 1st of December.

Mr. FRANCIS BASSETT seconded the motion, which was unanimously adopted.

Mr. HORNCASTLE then proposed a resolution increasing the Auditors' remuneration to 100 guineas each per annum. He considered this would be only fair remuneration for the responsibilities of auditing the accounts of such a company as theirs, and for discharging the other duties to which allusion had been made by the Chairman.

Mr. HOBSON seconded the motion.

Mr. SNOWDON inquired how long the audit generally took.

The CHAIRMAN replied that he could not state that it took any particular time; but there were documents which had to be signed perhaps two or three times in the course of a month. The time taken in auditing the accounts would depend a great deal on the capacity of the Auditors. Mr. Sebag Montefiore had had very considerable experience in auditing, and would probably get through in an hour what would take himself a week or longer. He thought that the Auditors, as he had said, ought to be remunerated in proportion to the work they did.

The motion was then agreed to *nem. con.*

Mr. DAVIDSON afterwards proposed a vote of thanks to the Chairman and Directors, remarking that they were always ready to perform their duties either on sea or land. No considerations about roughness of sea deterred the Directors from crossing to the Continent whenever it was necessary to do so in the interests of the Association.

Mr. HORNCASTLE seconded the motion, which was unanimously carried.

The CHAIRMAN, in acknowledging the vote, remarked that the confidence which the shareholders reposed in the Directors aided the latter very much in representing and defending the interests of the Association.

A vote of thanks was afterwards accorded to the staff, on the motion of the Chairman.

The proceedings then terminated.

BAHIA GAS COMPANY, LIMITED.

The Secretary of this Company (Mr. Thomas Guyatt) sends a copy of the report and balance-sheet submitted at the Ordinary General Meeting of the shareholders on the 2nd inst.

The report states that, at the general meeting on May 31 last, the Chairman informed the shareholders that it would be necessary to hold another meeting to receive the accounts for the period from Dec. 31, 1893, to May 17, 1894, as upon the latter date the Company ceased manufacturing gas in Bahia, and handed over the works and materials to the authorities in exchange for ten promissory notes of the Treasury of the State of Bahia, as sanctioned by the shareholders at the extraordinary general meeting held on March 22. The accounts to May last are given; and they show that, owing to the very low rate of exchange ruling during the whole time from Jan. 1, and to exceptional payments, the result did not admit of the distribution of a dividend for that period. Since the shareholders' meeting in May, the Directors and officers have been engaged endeavouring to obtain payment of the accounts due to the Company, and with fair success, taking into consideration the difficult circumstances in which they have been placed owing to the termination of the concession. The sums now outstanding—being principally accounts due by the Government and Municipality—will be handed over to the Company's Solicitor in Bahia for collection when the Manager leaves next month for England. This being the position of affairs, the Directors considered it unnecessary to retain the services of the staff, and recommended that a resolution be passed for putting the Company into liquidation. Although the shareholders have been already informed thereof, the Directors considered it desirable to repeat that they had received from the State Government ten promissory notes for £10,000 each, payable annually on the 17th of May, carrying interest in the meantime at the rate of 6 per cent. per annum. These securities are lodged for safe custody with the Company's bankers in Bahia; the first note being due in May, 1895. Questions having been raised regarding the legal rights and position in the liquidation of the several classes of shareholders, the Directors thought it desirable to take the opinion of Counsel thereon. A case was prepared by the Company's Solicitors, setting out the facts, and submitted to Mr. H. B. Buckley, Q.C. The following is his opinion:—

"This Company had not, under its original Memorandum and Articles of Association, any power to create preference shares. It could not, therefore, even by special resolution duly passed and confirmed, acquire power to issue such shares (*Hutton v. Scarborough Hotel Company*, 2 Dr. and S.M. 514, 521; 4 D.G.J. and S., 672). Apart, therefore, altogether from irregularities in the passing and confirmation of the resolutions, the rights of preference intended to be created never were validly created. The position of the 10 per cent. perpetual preference shareholders and of the 7½ per cent. preference shareholders, therefore, in my opinion is this—that they are holders of shares in the Company, but shares with no right of preference. In order to increase the capital, a special resolution was not required. (See Article 20 of original Articles and Article 74 of the substituted Articles of the Company. There exist now certain funds, arising in part from the sale of the undertaking, and in part from moneys which were or are alleged to have been accumulated profits. Against all these funds, all shares have, in my opinion, exactly the same rights. Whether they be profits or whether they be capital, they are distributable amongst all shareholders rateably. As regards payments made in the past, there is, I think, no right to recover them upon the footing that the preferential rights did not exist. These moneys were paid and received in the common belief that they were rightly paid. But the fact of such payments having been made in the past does not, in my opinion, create any right of preference as regards the future. Acquiescence as regards the future there can be none; and, moreover, to say the right was created by acquiescence, would be to say that the Company could thus do that which, *ex hypothesi*, the Company could not do. In my opinion, all the assets of the Company are to be distributed amongst all the shares *pari passu*. The question is one on which I think the Liquidators ought, for their own protection, to act under the directions of the Judge. They could obtain these directions at a very small expense by issuing a summons under section 138 of the Companies' Act, 1862, and putting the facts into an affidavit."

The Directors consider it right to say that neither they nor the Secretary were in office when the preference shares were created.

THE FINANCES OF THE SALFORD CORPORATION.

Local Government Board Inquiry—Sharp Strictures by an Inspector.

On Tuesday and Wednesday last week, Major-General Crozier and Mr. Edmund P. Burd held an inquiry for the Local Government Board at Salford into an application by the Corporation for power to borrow £36,371 for expenditure in the construction of baths, bridges, a hospital, refuse destructor, sewer, and fire station, and in the laying out of recreation grounds. The inquiry has only an indirect interest for readers of the JOURNAL; but it bears upon the question of the deficiency of £70,000, to which reference has been made in recent issues, and towards which it is proposed that the Gas Committee shall contribute £10,000 out of the current year's profits, and that £4000 shall be transferred from the water depreciation fund account. There was a large attendance of ratepayers, who appeared to be greatly in sympathy with Mr. Hempsall, one of the elective Auditors who opposed the application. The Town Clerk (Mr. S. Brown) appeared on behalf of the Corporation. Having made his opening statement, and given details of the various items of expenditure amounting in the aggregate to the sum applied for, Mr. Burd inquired of him why the Council did not ask for power to borrow the money before it was spent; and, in the course of his reply, Mr. Brown stated that, when the estimate of 1892-3 came to be made, he was afraid that a blunder was committed in under-estimating the expenditure of that year, so that at the end of 1893 they found themselves in this position—that they had a deficit which they thought would be fully covered by the £34,000, which was the amount of their first application. The actual deficit was £31,394; and this was the total of the deficits, without giving credit for any surpluses. Mr. Burd said he found, on looking into the figures, that the Corporation had at the time referred to overdrawn their banking account to the amount of £104,000. How, he asked, did the Town Clerk reconcile this with his statement that the deficit was only £31,000 odd? The Town Clerk replied that it had nothing to do with the deficit. They often found themselves in the position of having a large overdraft; and three or four months later, the amount might be cleared off and their account be in credit. The first item considered was £7000 for widening and strengthening Sherborne Street Bridge; and, during the discussion, Mr. Burd declared that ever since he had known the Corporation of Salford they had been doing the same sort of thing—carrying out works and afterwards going to the Local Government Board for sanction. The various other items were then considered. At the conclusion of the evidence, Mr. Burd read a paragraph which had appeared in *The Times*, in which, reporting briefly a recent meeting of the Town Council, it was stated that a Special Committee had been appointed to inquire into the deficits; and the manner in which it was proposed to make these good was indicated. It was said that the Local Government Board would be asked to sanction the borrowing of £34,000; and the remainder of the deficit—amounting in all to £70,000—would be contributed by the various Committees. Mr. Burd asked, Was the £34,000 the sum now applied for? The Town Clerk replied that it was; but they were simply dealing with the state of things in the years 1892-3. Mr. Burd said it was impossible to limit the inquiry to the deficit of £34,071. The Local Government Board were willing to do what they could to get

the Corporation out of the mess they were in—and that they had got into a mess there could be no doubt; but before this could be done, the Corporation must give full information, and be prepared to do what was right and proper. The Town Clerk expressed the willingness of the Corporation to do this. There was, he added, no desire on their part to withhold any particulars from the Local Government Board, but rather to give the fullest information, in order that they might get out of their difficulty—a difficulty such as he thought was not particularly uncommon with corporations. Mr. Burd remarked that it would be necessary to have a full explanation with regard to overdrafts, over-borrowing, and other matters; and to this the Town Clerk answered that the Corporation had not over-borrowed. If they had done so, it would have been illegal; but, though it was irregular, there was nothing illegal at all in an overdraft at the bank. He knew, too, that a banker had no claim upon a corporation for an overdraft. Mr. Burd further observed that he had had a great deal of trouble in connection with the finances of the Salford Corporation; but if they would come forward and say, "We wish to do what we can to put the finances on a proper basis," no one would be more ready to help than he would. The Corporation went to the Local Government Board for a little sum which was not really sufficient to straighten things up; whereas they might as well apply at once for a big amount that would put them right. The Town Clerk thought the Local Government Board had no power to give the Corporation more than the amount now applied for; and if the Board were to refuse to sanction the borrowing of the £34,000, the only course for the Corporation would be to go to Parliament with a Bill. They did not, however, want to put the ratepayers to this expense. Mr. Burd said probably the best way out of the difficulty would be to obtain a Provisional Order to allow them to alter their Local Acts. With the assistance of Mr. Crossley, Chief Clerk in the Borough Treasurer's office, the Inspectors went in detail through a number of the capital and revenue accounts, with the view of obtaining information on various points. Mr. Burd afterwards remarked that it appeared the Corporation had been in the habit of obtaining, without security, large overdrafts from the bank; and in some cases the amounts were greatly in excess of what would be covered by any borrowing powers that would be granted by the Local Government Board or by Parliament. It was desirable there should be a clear undertaking that the practice would be discontinued. Could he report to the Local Government Board that the Corporation would use their best endeavours to secure that these overdrafts should not be continued? The Town Clerk replied that the Corporation would do it as far as practicable; but there was bound to be an overdraft sometimes. There was not a Corporation in England that did not do it. Mr. Burd rejoined that there was not a Corporation in England that did it to the extent of the Salford Corporation. The Town Clerk considered, at any rate, it was simply a question of degree; and he promised to bring the matter before the Council who, he had no doubt, would do the best they could. Mr. Hempsall complained that the investigation should have stopped short at 1893; stating that it was an open secret that since that date the deficits had very much increased. To pass over the further deficits would be simply to continue the conspiracy of silence which had obtained for so long a time as to the accounts of the Corporation. Mr. Burd intimated that Mr. Crossley had promised to furnish him with the figures for 1894. In the course of further remarks, Mr. Hempsall suggested that borrowing powers should be obtained now for the total amount of the deficit; that the repayment should be spread over a considerable number of years; and that the Corporation should give a guarantee to the Local Government Board and the ratepayers that in future they would do their work before the eyes of the public. In reply to a question, Mr. Crossley said that the total debt of the Corporation at the present time was £1,925,000, of which £700,000 was applicable to profit-making undertakings, such as the gas and water works and the markets. The inquiry then closed.

THE THIRLMERE WATER-WORKS OF THE MANCHESTER CORPORATION.

The Arbitration Concerning the Lonsdale Estates.

At the Surveyors' Institution, Westminster, last Thursday week, Mr. C. Oakley, the Umpire appointed by the Board of Trade, continued the hearing of the case of the Hon. James Lowther, M.P., *v.* the Manchester Corporation. Mr. Ernest Page appeared for Mr. Lowther, who is Trustee for the Lonsdale estates, and whose claim is for compensation in respect of an easement effected by the construction of the Thirlmere aqueduct through Grasmere Common, Spital Farm, Kendal, and Hutton Roof Farm, Kirkby Lonsdale, and also in respect of stone used in the construction of the aqueduct through Westmoreland on lands over which Lord Londsdale is Lord of the Manor. Mr. Balfour Browne, Q.C., represented the Corporation.

At the previous sittings (*ante*, p. 658), the case for the claimant was disposed of; and Mr. Balfour Browne on the above-mentioned day commenced the case for the Corporation. He characterized the claim as being to a large extent unjustifiable in law and in fact. The whole case, he argued, was based on a series of fallacies both of fact and of law. The question of fact—the value of the article taken—would be established conclusively by the evidence. The Arbitrator was asked to consider the question as one between a willing buyer and a willing seller, and also the value of the material to the Corporation; but he protested altogether against the introduction of the phrase "willing buyer and willing seller." It was introduced with the view to get the Arbitrator to look at what were the needs and necessities of Manchester in respect to its water supply, and to get him to put a value on the article from that point of view. This fallacy was finally exposed and decided in the Countess Ossalinski's case. It was equally a fallacy to look at this aqueduct from the point of view of a wayleave. It was the value of the material taken from Lord Lonsdale, and the amount of damage done to him, that was the measure of what the Arbitrator must give. The next fallacy was that the Corporation by going there had made a market for the stone—that they had used the stone for concrete. It must be shown that apart from this the stone had a value; but the claimant's advisers wanted to value the stone not at its value to him, but to the Corporation. They admitted distinctly that they had not considered the damage done to Lord Lonsdale as the measure of the claim; and therein they were wrong. He was not suggesting that Lord Lonsdale should not receive payment for the stone taken; he only said that his lordship should be paid the worth of the stone to him. The question was, what damage had been done to Lord Lonsdale, not what benefit had been derived by the Corporation. Any damage must, of course, be paid for; and the damage in this case was nothing, because there were countless millions of tons of this stone in the bowels of the earth. The learned Counsel dwelt at length on the judgment of the Courts in the case of the Countess Ossalinski, where it was laid down that arbitrators were not to value land with reference to the particular purposes for which the land was required, especially where the matter was under parliamentary powers.

The first witness was Sir J. Harwood, the Chairman of the Corporation Water Committee, who said the claim was of such an iniquitous character that, if it was allowed, all public works would be stopped. In his opinion, the stone had no value in this case. Apart from Manchester's use of the stone, there would have been no market for the article for hundreds and perhaps thousands of years to come. He considered the Corporation had rather improved Lord Lonsdale's property than otherwise. At the same time, although there was nothing for which to pay, because nothing of value had been taken, he recognized the fact that Lord Lonsdale was Lord of the Manor, and would, as a matter of sentiment, offer some small recognition—sufficient to acknowledge the right. Questioned by Mr. Page, Sir J. Harwood said that even had the tunnel not gone through stone, the cost of the work would not have been materially different, because there was an abundance of stone in the neighbourhood to be obtained at an almost nominal cost. According to his view, no damage had been sustained by Lord Lonsdale; but they were willing to pay for the wayleave in the same way that they had paid everybody else. If the claim were allowed, it would not add materially to the cost of the Thirlmere scheme. The Corporation were resisting the principle, not the amount. He did not say the stone obtained from the aqueduct was worthless to the contractor for concrete, but it was worthless to Lord Lonsdale. He also mentioned that this was the last claim with which the Corporation had to deal. Mr. J. Bell, county surveyor, of Carlisle, also declared that the stone obtained from Lord Lonsdale's property had no commercial value.

On the following day, other witnesses gave evidence to the effect that the stone which was used in the construction of the Thirlmere aqueduct through Dunmail Raise, and which was worked up into concrete, had no commercial value whatever. The witnesses also testified that in their experience they had never known a Lord of the Manor claim for the stone obtained in this way, and used for concrete. Mr. Hodgson, a builder, of Grasmere, stated that on what was known as Grasmere Common and on the line of the aqueduct, there were many quarries; and the custom had been for anyone who wanted stone to go and get it. He had been in business himself for 38 years; and he believed the custom was hundreds of years old. He had never paid anything to the Lord of the Manor either as royalty or quarry rent for this stone; and the representatives of the Lord of the Manor had never attempted to exercise any control over him or anybody else. Mr. Page asked witness whether he was aware that the practice of taking away and selling this stone was absolutely unknown to Lord Lonsdale; and he replied that he was not, upon which Mr. Page observed that they were obtaining some useful information. Sir B. Baker was next called, and, referring to the contention on behalf of Lord Lonsdale that a commercial value was given to the subsoil by the fact of the Corporation having to pass through it, said if that principle were adopted in valuations for railways, the result would be absolutely chaos. In making a railway every yard of the stuff excavated would be used; and therefore a "commercial" value was given to the stuff. But in estimating the value, they must consider whether, under ordinary circumstances, the stuff would have been likely to be wrought, the period over which its excavation would be extended, and the evidence as to its value. If this were worked out, the value would be found to be so infinitesimal as not to be worth talking about. It was a fallacy to hold that the Corporation gave a commercial value to the material. Questioned by Mr. Page, he agreed that in a case where a railway company in making a cutting found stone for bridge building, the fact would have to be taken into consideration; but he would consider also in estimating the value whether the stone would have been wrought had the railway company not gone there, and also its plenteousness or scarcity in the neighbourhood. Mr. J. Smith, a valuer, of Bradford, followed with estimates showing that, in his opinion, the damage done to Lord Lonsdale's interest on Grasmere Common, Spital Farm, and Hutton Roof Farm was about £1300, which included £200 as a nominal recognition of his rights as Lord of the Manor. Replying to Mr. Page, he said he allowed nothing for the stone taken out of the aqueduct.

The case was concluded on the 4th inst., when Mr. Mansergh supported the evidence of the previous Corporation witnesses. If, he pointed out, public bodies were to be burdened with such outrageous payments as those claimed for a purely fanciful injury, a great impediment would be placed in the way of their schemes; and no engineer would be able to make trustworthy estimates of the cost of the undertakings. The introduction of the aqueduct created a theoretical rather than a tangible injury to the estate. He would allow £200 as an ackowledgment of the manorial rights; and in respect of the works through Grasmere Common, Spital Farm, and Hutton Roof, he allowed rather less than £1000. Mr. G. Hill, the Engineer of the Corporation, stated that the stone cost 30s. a cubic yard in some places to excavate, and that therefore its presence was a real drawback. Learned Counsel on both sides then addressed the Arbitrator at considerable length. The award will be presented in due course.

Reduction in Price.—The Directors of the Staines and Egham District Gas Company have decided to reduce the price of gas from 3s. 4d. to 3s. 2d. per 1000 cubic feet from the commencement of the new year.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

There have been other two appearances before Lord Low this week in connection with the latest Falkirk gas arbitration interdict. On Tuesday, Counsel appeared for Mr. Barr, whom it is sought to prevent acting as Oversman in the reference. He stated that Mr. Barr's position was that during a short visit to Falkirk in July nothing was disclosed to him at all; that on Oct. 3 he got a telegram asking if he could attend a meeting at Falkirk, following which a meeting was arranged for the forenoon of Oct. 9; but that upon that morning he received the letter from the Arbiters asking him to be Oversman; that he then telegraphed to Falkirk that he could not attend; that on the same day the Corporation consulted with their Edinburgh agent, who advised them not to allow Mr. Barr to accept the office; but that before the communication of that advice reached Mr. Barr, his appointment had been confirmed by the Arbiters. His position was that he had done nothing; but that if his appointment were cancelled, he should throw no obstacle in the way. He had no desire to take up a position to which he was not entitled; but he objected to an interdict being pronounced on the footing that he had disqualified himself, or had been disqualified in any way as suggested. He had seen no paper in the case; and did not know the method of getting it up. Lord Low thought that the true ground of objection to Mr. Barr had not been stated. If the Corporation had said that they had told Mr. Barr something which it was desirable to conceal from the Judge, that would have been different. He understood that the complainers were to bring an action to reduce the award. On that assumption, he thought he had better give them a well considered judgment. He accordingly continued the case till Thursday; and on that day he read his judgment (given on another page), which was in favour of the respondents, and found the Gas Company entitled to their expenses. His Lordship could not very well have acted otherwise; but it is a pity that he made the remark at the close of the hearing, that he thought it worth Mr. Barr's while to consider whether he would act. I think it might have been taken for granted that a man of Mr. Barr's honour would have been the first to consider that question; and that his decision would be that, the Court having declined to set him aside, he should act. Mr. Barr is certainly entitled to act as Oversman. If he is not to do so, it may be expected to be now a question with him whether he can, without loss of self-respect, act for the Corporation as witness. It will be awkward if the action of the Corporation should deprive both parties of the services of so eminent a man as Mr. Barr. It is possible now to fix upon the author of the proceedings. It was the Edinburgh agent who advised that Mr. Barr should be objected to; but he has somewhat overreached himself this time. It will be observed that, the interdict having been refused, the statutory three months are running again, since Thursday; and that, if it is not intended to allow the period to lapse, the arbitration must go on very soon. Perhaps it is the intention to tide over the three months, and then to have the price of the undertaking fixed by jury trial, which would be the only way open. The jury would sit before the Sheriff of Stirlingshire, I suppose, and would consist of twelve indifferent men, capable of sitting in jury in the Superior Court, selected out of twenty-four. Would it be possible to get twelve indifferent men who could apply their minds to the question of the value of a gas undertaking? I think not; but that might be a good reason for having them as judges. We all know the method juries have in fixing amounts. They each write down what they consider appropriate; and then the sum is divided by twelve. By the Corporation stating a low amount in their offer—as I believe the Corporation of Falkirk have done—suppose half the jury wrote down that amount, and the other half went to the top price asked by the Company, the price would be arrived at in this way: Six at £40,000 and six at £100,000, would make £840,000, which, divided by twelve, would give a price of £70,000. That is a good deal less than the Company would care to sell for. There is, in this sense, some temptation to the Corporation to have the matter settled by a jury. It is scarcely conceivable how a jury trial would benefit the Company; because the more ignorant people are, the more likely they are to be antagonistic to a public company.

There has been another case of poisoning by gas in Glasgow—happily, this time, without any loss of life. It was of a somewhat serious nature, however; for as many as five of one family were found in the morning in an unconscious condition. In this case, as in the two which happened two or three months ago, in which several persons were fatally affected, the gas came from outside the dwelling. No gas was used in the house; and there was an unoccupied shop between it and the street in which the main was fractured, from whence the gas came. The distance the gas travelled must surely have reduced its volume, and therefore, it might have been expected, its deadliness; but that does not seem to have been the case. All the five persons who were affected have recovered.

The municipal elections are over; and there appears to have been little change made in anything which affects the gas industry. In Glasgow, Mr. Ure, the Convener of the Gas Committee, though ill and unable to appear before the electors, was supported by colleagues who addressed meetings on his behalf; and though opposed by a person of socialistic leanings, he was returned triumphantly. It was a splendid tribute to his business capacity that his colleagues should have fought so manfully for him. Mr. Kinloch Anderson, who has developed into the leader of the Edinburgh and Leith Gas Commission, was returned to the Town Council unopposed; and has had the honour conferred upon him of being elected a Bailie of the city. He will doubtless be retained by the Gas Commission as Convener of the Works Committee. Mr. Kinloch Anderson thoroughly deserves the honour. In Aberdeen, Mr. Johnston has been re-appointed Convener of the Corporation Gas Committee. Of course, in Dundee there has been a big change—from the Gas Commission to the Corporation—but the men are very much the same who will conduct the gas undertaking; and at their head is Mr. Brownlee, who, hitherto Convener of the Works Committee of the Commission, has now been appointed Convener of the Corporation Gas Committee. There is one thing in the elections at which I feel glad—namely, that Mr. Adam Pratt, who stood for one of the wards in Aberdeen, has not been returned. He was in the Council some years ago; and I was able to get a good deal of copy out of his doings. But as I did not admire his ways, I am willing to forego the good things which would have fallen to me had he been returned, for the sake of seeing the Aberdeen Corporation gas undertaking managed in a peaceable manner.

The Corporation of Paisley in 1891 obtained a Provisional Order empowering them to supply electricity, and giving them two years in which to supply the compulsory area. They have done nothing with the Order; and now Nemesis is upon them, in the shape of the Caledonian Electric Supply Company, who have given notice of an application for a Provisional Order giving them the powers which the Corporation have not exercised. A Committee of the Town Council have consulted with Mr. Bryson, Electrical Engineer of Glasgow, one of the most competent in his profession; and he has given them the very sensible advice that electricity would cost four times what gas does at 2s. 10d. per 1000 cubic feet. He also advised them not to exercise their powers under the Order they hold; but to try to transfer it, if they can get suitable terms. It has therefore been resolved to invite offers.

The Corporation of Glasgow had before them, on Monday, a report as to the working of the incandescent gas-lamps they have had in use for some time in a portion of St. Vincent Street. The lamps were fitted up—five of them to consume 5 cubic feet, and the others 3½ cubic feet per hour. It was found that the mantles of the larger lamps did not last so long as those of the smaller; and consequently they have all been converted into 3½ cubic feet lamps. It is proved that the cost of gas for the ten lamps would be £17 3s. 3d. per annum; while the cost for gas consumed in those which were displaced was £39 13s. 10d. There is thus a saving by the use of the incandescent lamps of £22 10s. 7d. a year. The cost of the lamps was £11 5s.; and the saving on the first year will thus be £11 5s. 7d. During the course of the experiment, four mantles had been replaced, at a cost of 6s. 4d. The Lighting Committee are so satisfied with the results, both in economy and in lighting power, that they have directed that incandescent gas-lamps be erected in Gordon Street and George Street. The recommendation was adopted. Bailie Primrose, moving it, said the Committee had every confidence that incandescent gas lighting would play an important part in the future lighting of the city.

An installation of the Peebles oil-gas process has been introduced into the Broughty Ferry Corporation Gas-Works. The plant was set going on the evening of Saturday last. Early this year, regenerative settings upon the design of Mr. G. R. Hislop, of Paisley, were introduced, by means of which it is now possible to make as much gas in twelve retorts as was formerly made in twenty; and only about half the quantity of fuel formerly required is now used. The oil-gas plant consists of eight retorts; and they are expected to produce 36,000 cubic feet of gas per twenty-four hours. A store tank, capable of holding 30 tons of oil, has been constructed, into which the railway tank waggons discharge; and from it the oil flows into a smaller service tank, from which it is pumped into the condenser, according to the system. The Manager (Mr. F. Waddell) expects that his works are now equipped to serve the community for a long time.

Mr. Ballantyne, Manager of the Rothesay Corporation Gas-Works, is at the head of a works which are so successful that it will very soon be necessary to have them removed to another site, in order to get room for extensions. A municipal candidate stated the other night that in 1889 the amount received from gas consumers was £3887; and that last year it was £4640—an increase of about 20 per cent. in five years. Last year they had £628 of surplus on the gas account. Although the gentleman did not say it, I presume that the large increase in the gas consumption is due to Mr. Ballantyne's energetic pushing of the cause of gas cookers and heaters, of which he is a strong advocate.

Electric Lighting in St. Pancras.—The St. Pancras Vestry, at their meeting last Wednesday, approved of a scheme submitted by the Electricity Committee for supplying the remainder of the parish with the electric light. The estimated ultimate cost of the entire new works is £48,565. The Committee were authorized to proceed forthwith with the laying of mains in a large area to be served by the King's Road station, which is rapidly approaching completion. When these works were originally planned in July last, it was calculated the expense would be £28,000; but, having regard to the present reduced price of copper, it is anticipated that a saving of £6000 will be effected in the estimate with respect to this material alone.

Disputed Meter Registration.—At the Westminster County Court, last Wednesday, before his Honour Judge Lumley-Smith, Q.C., the case of *The Gaslight and Coke Company v. Robertson* was tried. It was an action to recover £19 8s. 10d., the balance of an account for gas supplied and the rent of stoves and a 10-light meter. Mr. Hodges appeared for the plaintiffs. Evidence was given that the Company commenced to supply gas to the defendant in December last, at Ridgemount Gardens, W. She only used it at that time for heating, and had six stoves; but she afterwards had a cooking-stove fixed. When the index of the meter was inspected in March, it only registered 200 cubic feet; and for this quantity she paid. On June 19 last, the state of the meter was taken and found to be 125,000 cubic feet. Thinking this to be too much, the Company sent on the following day, and saw that 300 cubic feet of gas had been consumed. Then, on searching the books, they ascertained that, when the cooking-stove was fixed in February, the meter had registered 45,800 cubic feet. The meter previously fixed was tested by officers of the London County Council; and the witness from the testing-station said it was not a new one, and had been repaired. Defendant said she only had one fire alight at a time, and the quantity of gas for which the Company had charged her was too great. His Honour found for the plaintiffs for the amount claimed—the meter being, he said, *primâ facie* evidence for the consumption; but, as there had been a mistake on the part of the Company, he would not allow costs.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Nov.* 10.

Sulphate of Ammonia.—The sudden lowering of both spot and forward quotations by speculative dealers has once more frightened buyers away; and where there was a certain show of eagerness a week ago, there is now a blank as far as the demand is concerned. This only proves the sensitive condition of the market, when, after a sharp rally, quite unexpectedly a dead calm supervenes. It also shows that buyers have requirements, the filling of which is a serious item to them; the higher or lower price according to circumstances making such a considerable difference in their revenue. Forward business has, in consequence, also received a check; and though it is hard to believe, it is positively stated that some venturesome spirits have been quoting as low as £12 10s. for delivery in the spring. Makers cannot do better than look on meanwhile. Spot quotations are again in the neighbourhood of £12 5s.

LONDON, *Nov.* 10.

Tar Products.—Notwithstanding the gradually increasing output of tar products, the position of the market continues favourable. Benzols have little life; but, although business is not so readily placed, the values have not been seriously affected during the week. Creosote and oils are in good demand; and several large contracts are expected shortly on the market. The quantity of Scotch oil now available has rather eased the values in the Northern markets. It was expected that the Scotch pitch would have the same effect. But so far, this has not been the case; and prompt and forward business have been done at top prices. Carbolic acid is weaker; and cresylic acid is in very poor demand. Prices may be taken as follows: Tar, 16s. 6d. to 21s. Pitch, prompt, 40s.; forward, 37s. 6d. Benzol, 90's, 1s. 2d.; 50's, 1s. 2d. Solvent naphtha, 1s. 3d. Toluol, 1s. 3d. Crude naphtha, 5½d. Creosote, liquid, 2¼d.; ordinary, 1¼d.; salts, 17s. Cresylic acid, refined, 1s.; brown, 10d. Carbolic acid, 1s. 4½d. Anthracene, "A" quality, 1s. 1d.; "B," 10d.

Sulphate of Ammonia, contrary to expectation, has had a check; and whereas business was possible a week ago at £12 15s. to £12 17s. 6d., the current prices are: London, £12 10s.; Hull, £12 5s.; and Leith, about £12 3s. 9d. Gas liquor is quoted at 7s. to 10s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Plentiful supplies of all descriptions of fuel, pits working short time, and prices weak, with rather a downward tendency in some cases, is the general report as regards the condition of the coal trade of this district. The better qualities for house-fire purposes still meet with only a very moderate inquiry for the season of the year; and prices are barely being maintained. Best Wigan Arley is only in exceptional cases fetching more than 11s.; Pemberton four-feet and seconds Arley being freely offered at 9s. 6d. to 10s.; and common round coal, from as low as 7s. 6d. to 8s. per ton at the pit. Steam and forge qualities continue in very indifferent demand, either for inland requirements or for shipment; and extremely low prices are being taken. At the pit mouth, ordinary steam and forge coals can be bought at from 6s. 6d. to 7s.; and for shipment, 8s. to 8s. 6d. is being taken, with some of the better qualities quoted at 9s. per ton, delivered at the ports on the Mersey. Engine classes of fuel continue so much a glut upon the market that prices are altogether irregular, owing to surplus supplies being pushed for sale in many cases at almost any price that buyers are prepared to offer; and the Manchester firms have had to bring their list rates down to what have previously been their actual selling prices in competition with slack coming in from the outside districts. At the pit mouth common Wigan slack can be readily bought at 3s. to 3s. 6d., with best sorts quoted 5s. to 5s. 6d.; and slack from other districts is offering at about 1s. 6d. per ton.

Northern Coal Trade.—There has been a further fall in the price of one or two kinds of coal, due in a large degree to the derangement of the trade by stormy weather, and to the withdrawal of orders for some of the Baltic ports. For gas and household fuel, there is an increasing demand, which counterbalances the fall. But this is not the case with steam coals; and hence the price of the latter is much weaker and lower. Best Northumbrian steam coals are quoted at 10s. per ton f.o.b.; second qualities are about 9s. 6d.; and steam smalls, 4s. 3d. There is very little alteration for manufacturing coals; but the tendency in prices is towards a slightly lower level for the contracts now being negotiated for the next year. A fair inquiry also prevails for smithy coal. Gas coals now meet with a very large demand; and as the deliveries will soon be at the highest point, the output is well taken up. One or two contracts have been settled for Austrian and Danish towns; the price generally being at about 7s. 2d. per ton f.o.b. For odd cargoes, the price ranges from that just given up to about 7s. 9d. per ton; but as there is not now any strike to drive orders out of their usual course, rates are not quite so high as a year ago. Coke is still keeping quiet; the foreign demand being a rather limited one, though the local consumption is large. Best Durham coke is quoted at 13s. to 14s. per ton f.o.b. There is no alteration of moment in the price or position of gas coke this week.

Scotch Coal Trade.—The coal trade in Scotland continues active; but prices, except in the case of splint, are scarcely maintained. Steam coal is in fair demand; and ell is being exported largely. The miners are working five days a week, and are turning out large quantities. It is regarded in some quarters as likely that most of the iron, steel, and gas works, have laid in considerable stocks since the strike ended; and the prices will thus get easier as the winter advances. They are likely to recede yet; but not so much on that account as owing to the fact that trade outside Scotland is at present stiff, on account of contracts having gone elsewhere. Scotch coalmasters can do very little trade in Ireland—the prices being too high; and not much can be expected until the masters are able to offer coal cheaper. The quotations are: Main, 8s. 3d. per ton f.o.b. Glasgow; ell, 9s. to 9s. 3d.; splint, 9s. 3d. to 9s. 6d.; and steam, 9s. to 9s. 3d. The shipments for the week amounted to 141,960 tons—an increase as compared with the previous week of 31,450 tons; but a decrease as compared with the corresponding week of last year of 85,628 tons. For the year to date, the shipments have been 4,207,299 tons—a decrease, when compared with the same period of last year, of 2,533,288 tons.

Electric Lighting in Paris.—According to *L'Industrie Electrique*, the electric lighting of Paris is divided between six companies and one public authority. The lamp-connections of the stations are not given; but the *Electrician* estimates them at something like 325,000 8-candle lamps, as compared with 700,000 lamps of this power in London, where there are eleven companies and two municipalities engaged in the service.

The Leicester Corporation Water Supply.—Alderman Wood, the Chairman of the Leicester Corporation Water Committee, reported, on the 5th inst., that the total average daily inflow of water from the auxiliary sources during the preceding seven days was 1,290,943 gallons. The stock of water in the reservoirs was 124¼ million gallons, as against 109 millions at the beginning of the previous week. The stock in the reservoirs on the corresponding day of last year was 171 million gallons.

Accident at the Macclesfield Gas-Works.—A brief account has reached us of an accident (fortunately, as far as we can learn, unattended by personal injury) which occurred at the Macclesfield Gas-Works last Sunday. It appears that two girders, forming a portion of the coal-store floor over the River Bollin, collapsed, and blocked the stream, the water of which flooded the yard, and surged into a silk-mill. A gang of men set to work and temporarily diverted the course of the water, the rush of which was very great. We understand that the girders were put up about four years ago.

The Gas and Water Works Purchase Question at Chesterfield.—The invitation of the Chesterfield Town Council to the Local Authorities of the adjoining districts to take part in the promotion of a Bill for the acquisition of the gas and water works of the Chesterfield Water and Gas Company has been considered during the past week by the Chesterfield Rural Sanitary Authority, the Newbold and Dunston Local Board, and the Whittington Local Board. The first-named Authority do not see their way to join the Council; but the second have unanimously agreed to join. The Whittington Board consider it "advisable" that they should also do so.

North Bierley Gas Company and the Local Colliers.—A meeting, convened by the local branch of the Miners' Association, was held at Wyke last Wednesday, at which a resolution was passed asking the inhabitants in the area supplied by the North Bierley Gas Company to help the miners to get the Company to purchase their coals in the district, seeing that they had to burn their gas. It was stated that during the past three months employment for the miners had not averaged more than two and a quarter days per week; and it was contended that, in proportion to its value, as good gas could be obtained from local coal as from any class of coal in the country. Strong objection was also made to the Company's charge for meters; and a suggestion that if the request to the Company were not acceded to consumers should cease to use the gas, was readily approved.

The Failure of the Promoter of the British Water-Gas Company.—In the London Bankruptcy Court last Wednesday, before Mr. Registrar Giffard, there was a sitting for public examination in the case of John C. Cottam, a financial agent and company promoter, the statement of whose affairs showed liabilities to the extent of £103,936, of which only £5436 are expected to rank, while the available assets are *nil*. The debtor, it may be remembered, was the promoter of the British Water-Gas Company. Mr. E. S. Gray, the Assistant Official Receiver, stated that the accounts had only recently been filed, and he had not had sufficient time to investigate them. They would require amendment; further particulars being necessary with reference to a contingent liability of £100,000 which had arisen in connection with the firm in which the debtor was formerly a partner. An adjournment till Jan. 16 was granted.

The Water, Gas, and Electricity Accounts of the Bradford Corporation.—In an article on "A Year's Finance of the Bradford Corporation," the *Bradford Observer* makes the following remarks concerning the accounts of the Water, Gas, and Electricity Departments: With regard to the Water Fund Revenue account, "although no rate in aid has been required during the year, and, as appears from the estimates, nothing is asked during the year 1894-5, yet the excess of expenditure is not of such dimensions as to justify the hope of immunity in the near future. With the Nidd scheme before Alderman Holdsworth and his colleagues on the Water-Works Committee, it is probable that they will have to ask for a rate in aid, unless next year the income is proportionately larger than that of the past. The total income for the municipal year just ended was £127,800; and the expenditure (which includes interest and sinking fund) was £127,296—leaving a net income of £504. The water fund capital account shows receipts of £12,884, and payments of £53,779; the difference of £40,895 having been previously borrowed and in hand at the commencement of the year. The gas revenue account shows an income from all sources of £197,846; and an expenditure of £179,960, or a trade profit of £17,886. Against this is charged interest, sinking fund, &c., of £29,176, resulting in a net loss of £11,290, mainly caused by the coal strike. It should also be borne in mind that the lighting in the borough, which costs about £20,000 a year, is done by the Gas Committee free of charge. There is still in hand a reserve of profits from previous years of £12,600, after charging to those reserve profits the loss just mentioned. The electricity revenue account shows an income of £10,822 and an expenditure on trade account of £5203; making a gross profit of £5619, against which is charged interest, sinking fund, &c., amounting to £3480, leaving a net profit of £2139. Thts is the largest profit the department has yet made during one year. The total net profits to date since the works were opened amount to £3409. This sum may be used either in depreciation of stock or in relief of rates, as the Committee may determine."

Sequel to a Gas Explosion.—At the Preston County Court on Monday last week, Thomas Brooks and Thomas Whiteside brought actions to recover damages for injuries sustained by them through a gas explosion at the Angler's Inn, Preston. It was alleged that, though the landlord's attention was drawn to an escape of gas, he struck a light and an explosion ensued. Plaintiffs were badly burned, while another man was rendered unconscious. His Honour Judge Coventry awarded Brooks £10 and Whiteside £7.

New Water Company for the Weald of Kent.—A meeting was lately held at Cranbrook, to consider the advisability of establishing a water undertaking for the Weald of Kent. Mr. E. P. Seaton, M Inst.C.E., said a bore-hole had been sunk at Hawkhurst to a depth of 300 feet, and excellent water had been found. The boring had been taken 200 feet through hard grey shell, and pumps were run 36 consecutive hours, raising 1200 gallons of good water per hour. It was proposed to sink at Hawkhurst a well 7 feet in diameter, cased with cast-iron cylinders. They would go down until the blue clay was met with, after which blue brick would be used until the water was reached at a depth of between 200 and 250 feet. Collecting headings would then be driven, so as to ensure a sufficient supply. A pump-house would be erected, and water would be raised to a reservoir to be constructed on land 450 feet above sea-level. The water would be supplied by gravitation; and the reservoir would be large enough to contain a week's store, taking the whole population, and allowing them 20 gallons per head per day. The estimated cost of the works was £13,000; and the working expenses were put at £350 per annum. If only half of the population took the water, it would, it was calculated, assure a yearly income of £1387, and thus provide a net profit of 8 per cent. per annum. It was resolved to take steps for the formation of a company, for which purpose a committee was elected.

The Charge against a Trade Union Secretary.—Joseph Greaves, the Secretary of the Sheffield District of the Gas Workers' and General Labourers' Union, was again brought up at the Sheffield Police Court last Tuesday, and charged, under the Trade Union Act of 1871, with withholding the sum of £252 odd, the money of the Society. The facts of the case were briefly stated last week. Mr. Neal, who appeared for the prosecution, now said that, about Sept. 26, defendant withdrew £110 from the bank (having obtained the necessary signatures to a note), for the purpose of remitting it to headquarters. This he failed to do—in fact, he absconded, and remained away until the previous Friday, when he was apprehended. Since then the accounts of the Society had been investigated by the Auditor; and a deficiency was found of £252. Greaves had given assistance which had led to the recovery of a considerable sum of the money; and Mr. Neal added that the prosecution had reason to believe that he had not been acting entirely on his own motion, but that he had been instigated by people probably more culpable than himself. Considering all the circumstances, the prosecution, he said, would be content to take the Stipendiary's order for the sum of £120, with any penalty which his Worship thought fit or necessary to inflict; the money in the hands of the police to be applied towards payment. It was a case where the man had had a good character for 16 years; and there was no desire on the part of the Society to be vindictive. Mr. Wilson, for defendant, said his instructions were to plead guilty to withholding the money. He characterized the case as a sad ending to what was thought to be a promising career. The man was for fifteen years employed by the Sheffield Gas Company at wages of 22s. a week; but he suddenly found himself a gentleman with nothing to do, and an income of 35s. a week. He was a man who had not been brought up to the luxury of doing nothing, and getting an income. For four years and nine months, he appeared to have been able to withstand the blandishments of his new office; but in the last three months, he had been led astray. The Stipendiary ordered that the £120 should be delivered up, and that Greaves should pay a fine of £5 and costs £1. The warrant for larcency as baille was withdrawn.

The Felixstowe Local Board and the Water Company.—In accordance with the instructions received by him at the recent meeting of the Felixstowe Local Board, the Clerk addressed a letter to the Secretary of the Water Company (Mr. I. L. Ensor), informing him of the course the Board proposed to pursue with reference to the acquisition of the water-works. To this letter, Mr. Ensor has replied that his Directors, although they have no desire to sell their undertaking, are perfectly willing to afford the Board the opportunity of acquiring it on fair terms, and are prepared at once to endeavour to arrange an agreement for sale, which shall be confirmed by an Act of Parliament in the coming session. They also desired to point out that during several years a large capital expenditure has been incurred to afford a proper water supply to the district which has not received any adequate return; and that the present income does not fairly represent the return which will be earned by the money already expended. It would not, therefore, be fair to attempt to buy a progressive and improving undertaking for 25 times its ascertained income. The value of the undertaking, Mr. Ensor says, can only be ascertained in the way suggested by the Directors at the interview which they had with a deputation from the Local Board on Sept. 18 last—viz., for the Board to appoint an expert to act on their behalf who shall meet Mr. Mansergh and endeavour to agree on the proper price to be paid for the property. The present members of the Local Board will soon, he also points out, go out of office; and there is no security that their successors will desire to purchase the water-works. The Directors are, therefore, unable to accept the suggestion that they should defer their application to Parliament; but having regard to the negotiations which have taken place, they will provide in their parliamentary notice for the possibility of a sale to the Board, in order that, if terms are arranged, they can be confirmed, and the sale carried out by the Bill for which they propose to apply this session. The Local Board, having considered this letter, have passed a resolution expressing their willingness to have the amount to be paid for the purchase of the undertaking fixed by two experts or their umpire; but since then a meeting of owners and ratepayers has rejected the usual resolution consenting to the promotion of a Bill. The result is that the Board have decided to discontinue negotiations with both the Gas and the Water Company.

A New Loan for the Sheffield Corporation Water Department.—Last Wednesday, Mr. Rienzi Walton, held an inquiry at Sheffield in reference to an application by the Corporation to the Local Government Board for sanction to borrow £9959 for water-works purposes, the details of which were explained by the Deputy Town Clerk and the Water Engineer (Mr. E. M. Eaton). There was no opposition.

The Purchase of the Barry and Cadoxton Gas and Water Works by the Local Board.—The Barry and Cadoxton Local Board are proposing to take over the undertaking of the Barry and Cadoxton Gas and Water Company during the present month; and it will be carried on in future under the control of the District Council. For the purpose of completing the purchase, the Board have secured stock to the extent of £200,000 at 3 per cent., redeemable at the option of the Board in 20 years, and to be otherwise extinguished in 52 years. They have also, it is understood, completed arrangements for the issue of stock to that extent.

Gas and Electric Lighting at Bolton.—In the "Electric Lighting Notes" in last Tuesday's JOURNAL (p. 886), we recorded the formal opening of the new electricity works of the Bolton Corporation; the ceremony being performed by Alderman Miles, J.P., the Chairman of the Gas and Electric Lighting Committee. At the banquet which subsequently took place in the Town Hall, Alderman Miles, responding for his Committee, referred to the positions of the two undertakings under their control. He remarked that he was not afraid that the electric light would interfere with the results of the Gas Department; on the contrary, he believed it would promote that particular branch of the Corporation work. There was room for both systems; and if the inhabitants helped the Committee as they ought to do, they would soon produce a most satisfactory balance-sheet for electric lighting as well as gas. Referring to the question of price, he said it would be about half as much again as gas. Mr. Siemens, in proposing "Success to the Bolton Electricity Works," said he had introduced electricity into every room in his house, and found that there was not a penny increase in the cost as compared with gas. As to electricity being likely to diminish the profits of gas undertakings, it was quite a wrong impression. The electric light would benefit the gas, for while the former would advance as an illuminant, the use of the latter would extend for heating, cooking, and motive power.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 913.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	11 Oct.	10½	Alliance & Dublin 10 p. c.	10	19—20	..	5 5 0
100,000	10	,,	7½	Do. 7 p. c	10	13—14	..	5 7 2
300,000	100	2 July	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 4
200,000	5	11 May	6½	Bombay, Limited	5	6¼—6¾	..	4 16 5
40,000	5	,,	6½	Do. New	4	4¼—4¾	..	5 9 6
380,000	Stck.	15 Aug.	11½	Brentford Consolidated	100	230—235	..	4 17 10
180,000	,,	,,	8½	Do. New	100	177—182	..	4 13 4
220,000	Stck.	28 Sept.	11	Brighton & Hove Original	100	213—218	..	5 0 11
888,500	Stck.	30 Aug.	5	Bristol	100	115—120	..	4 3 4
320,000	20	28 Sept.	11½	British	20	48½—49½	..	4 10 10
50,000	10	30 Aug.	11½	Bromley, Ordinary 10 p. c.	10	21½—22½	..	5 2 2
51,510	10	,,	8½	Do. 7 p. c.	10	16¾—17¾	..	4 17 2
328,750	10	28 June	2	Buenos Ayres (New) Limited	10	6¾—7¼	..	2 15 3
200,000	100	2 July	6	Do. 6 p. c. Deb.	100	101—104	..	5 15 5
150,000	20	12 July	8	Cagliari, Limited	20	25¼—26¼	..	6 0 8
550,000	Stck.	11 Oct.	13	Commercial, Old Stock	100	267—272	..	4 15 7
165,000	,,	,,	10	Do. New do.	100	195—200	..	5 0 0
160,762	,,	14 June	4½	Do. 4½ p. c. Deb. do.	100	132—137	..	3 5 8
800,000	Stck	14 June	13	Continental Union Limited	100	242—247	..	5 5 3
200,000	,,	,,	10	Do. 7 p. c. Pref	100	210—215	..	4 13 0
535,000	Stck.	30 Aug.	5	Crystal Palace Ord. 5 p.c. Stk	100	115—120	+3	4 3 4
486,090	10	27 July	11	European, Limited	10	22¾—23¾	..	4 13 7
354,060	10	,,	11	Do. Partly paid	7	16—17	..	4 17 1
5,646,590	Stck	15 Aug	12	Gaslight & Coke, A, Ordinary	100½	248—252	..	4 15 3
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	105—110	..	3 12 9
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	277—282	..	3 10 10
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	130—135	..	3 14 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	200—205	..	3 13 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	180—185	..	3 15 8
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	275—280	..	3 11 5
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	165—170	..	3 10 7
1,061,150	,,	14 June	4	Do. 4 p. c. Deb. Stk.	100	127—130	..	3 1 6
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	132—137	..	3 5 8
908,000	,,	,,	6	Do. 6 p. c. do	100	180—185	..	3 4 10
3,800,000	Stck.	11 May	12	Imperial Continental	100	230—235	..	5 2 1
75,000	5	14 June	6	Malta & Mediterranean, Ltd.	5	5—5¼	..	5 9 1
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	100	109—111	..	4 10 1
541,920	20	14 June	5	Monte Video, Limited	20	15½—16¾	+¾	6 1 4
150,000	5	30 May	8	Oriental, Limited	5	7—7⅛	+⅛	5 6 8
60,000	5	13 Sept.	7	Ottoman, Limited	5	4¼—4¾	...	7 7 4
166,870	10	31 Jan.	2	Pará Limited	10	1½—2	..	10 0 0
420,000	100	2 Nov.		People's Gas of Chicago— 1st Mtg. Bds.	100	100-105*	..	5 14 3
500,000	100	1 June	6	2nd Do.	100	98—103	..	5 16 6
150,000	10	11 Oct.	6	San Paulo, Limited	10	9—9¼	..	6 6 4
500,000	Stck.	30 Aug.	15½	South Metropolitan, A Stock	100	333—338	..	4 11 9
1,350,000	,,	,,	12	Do. B do.	100	280—285	..	4 4 3
260,000	,,	,,	13	Do. C do.	100	288—293	..	4 8 9
750,000	,,	12 July	5	Do. 5 p. c. Deb. Stk.	100	156—161	..	3 2 2
60,000	Stck.	30 Aug.	11½	Tottenham & Edm'nton, "A"	100	220—225	+5	5 2 2
				WATER COMPANIES.				
746,011	Stck.	28 June	10	Chelsea, Ordinary	100	288—293	..	3 8 3
1,719,514	Stck.	11 Oct.	8	East London, Ordinary	100	230—235	..	3 8 1
654,740	,,	28 June	4½	Do. 4½ p. c. Deb. Stk.	100	150—154	..	2 18 5
700,000	50	14 June	8½	Grand Junction	50	120—124	..	3 8 7
708,000	Stck.	15 Aug.	12	Kent	100	302—307	..	3 18 2
1,043,800	100	28 June	9½	Lambeth, 10 p. c. max.	100	268—273	..	3 9 7
406,200	100	,,	7½	Do. 7½ p. c. max.	100	209—214	..	3 10 1
330,000	Stck.	28 Sept.	4	Do. 4 p. c. Deb. Stk.	100	132—135	..	2 19 3
500,000	100	15 Aug.	12½	New River, New Shares	100	384—388	+1½	3 2 6
1,000,000	Stck.	27 July	4	Do. 4 p. c. Deb. Stk	100	140—145	+2	2 15 2
902,300	Stck.	14 June	6	S'thwk & V'x hall, 10 p. c. max.	100	168—173	+1	3 9 5
126,500	100	,,	6	Do. D 7½ p. c. do.	100	157—162	+2	3 14 1
1,155,066	Stck.	14 June	10	West Middlesex	100	277—282	..	3 10 10

*Ex div.

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PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 2698.

GWYNNE & CO.,

HYDRAULIC AND GAS ENGINEERS,

BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

Late ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON.

They have completed Exhausters to the extent of 32,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, PATENT RETORT-LIDS, STEAM, PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

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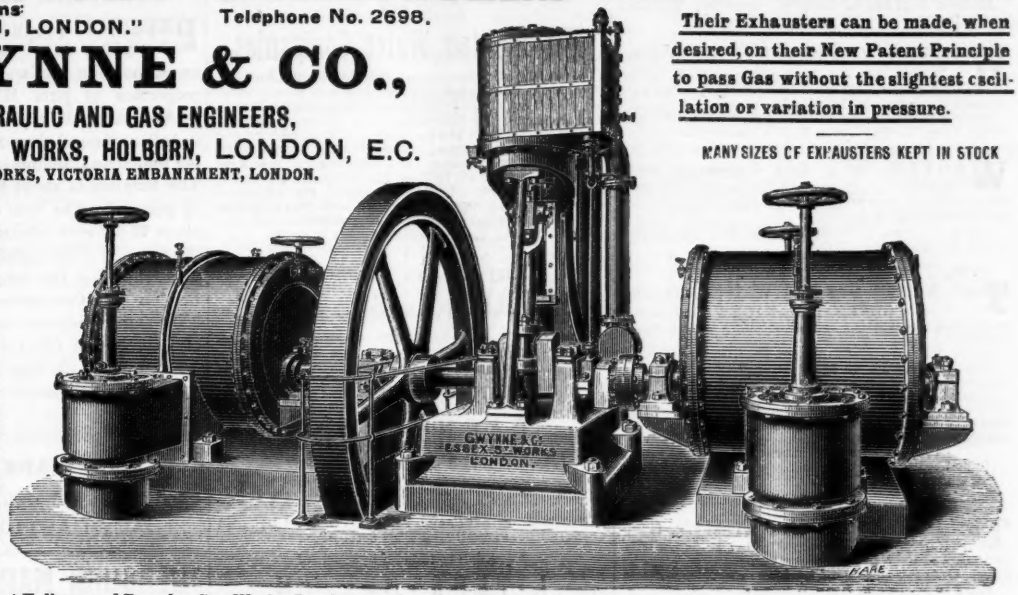

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Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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JOHN WM. O'NEILL, Managing Director.

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ANDREW STEPHENSON, Agent. All communications *re* OXIDE to be addressed to PALMERSTON BUILDINGS, E.C.

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BROTHERTON AND CO., Chemical Manufacturers.
Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BROTHERTON & CO.
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Correspondence invited.

REDHILL GAS-WORKS ASSESSMENT APPEAL.

THE Report of the Proceedings at the hearing of the APPEAL of the REDHILL GAS COMPANY against the RATING OF THEIR PROPERTY in Reigate and Nutfield which was published in the JOURNAL has been now reprinted in Pamphlet form; and copies can be obtained, on application to the PUBLISHER, *price 4d. each.*

NOTICES FOR POSTING IN GAS-WORKS.

CARDS suitable for Exhibiting in Gas- Works, directing Officers and Workmen to REPORT all ACCIDENTS witnessed by them, together with the Clause of the "NOTICE OF ACCIDENTS ACT, 1894," specifying the notice required to be sent to the Board of Trade, can be obtained, *price 4d. each, or 2s. 6d. per dozen, post free.*
Section 4 of the "CONSPIRACY AND PROTECTION OF PROPERTY ACT, 1875," has been similarly printed. It is required, under a Penalty of FIVE POUNDS, that a Copy of the Section shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by persons employed thereat. Copies, in large type, on broad sheets (22½ inches by 17¼ inches) may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C. *Price 2s. per dozen; 10s. 6d. per 100.* On Cards the same size as those relating to the "Notice of Accidents Act," *price 4d. each or 2s. 6d. per dozen.*

W. C. HOLMES & CO., Huddersfield; AND 80, CANNON STREET, LONDON,
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*** See Advertisement p. III., centre of JOURNAL.
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FOR ALL LEAKAGES.

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HYDRATED OXIDE OF IRON.

PREPARED from pure Iron
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
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WANTED, Commissions or Agency for Australia, Tasmania, and New Zealand, by a thoroughly practical hand.
In strict confidence, address No. 2450, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Situation as Meter In- SPECTOR or CLERK. Age 25 years. Ten years' experience in a Provincial Gas-Works.
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WANTED, by a Competent Man, a Situation as SERVICE LAYER, METER FIXER, STOVE FIXER, INDICE READER, MAIN TESTER, &c. Total Abstainer.
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WANTED, a Manager for a Small Gas- Works on the East Coast. Make about 14 Millions a Year. He must be thoroughly acquainted with all the details of Gas-Works.
Apply, by letter, with testimonials, to No. 2447, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a Gas Company near London, a suitable Man as MAIN and SERVICE LAYER, FITTER, &c. Only those who are used to the work need apply.
Apply, by letter, to No. 2451, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Ystrad Gas and Water Company require a GENERAL MANAGER for their Gas and Water Undertaking in the Rhondda Valley, Glamorganshire.
Salary £200 a year, with House, Fuel, Gas, and Water.
Make of Gas from 60 to 70 Million Cubic Feet per Annum.
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JOHN L. COCKER,
Manager and Secretary.
Gas Offices and Works,
Merthyr Tydfil, Glamorganshire,
Oct. 22, 1894.

NOTICE.
IN THE HIGH COURT OF JUSTICE,
CHANCERY DIVISION,
MR. JUSTICE ROMER.
THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED,
v.
HIRSCHFELD and Others.

BY Injunction this day granted—the Defendants their Servants or Agents were restrained from Infringement of the Letters Patent granted to Carl Auer von Welsbach and Oliver Imray for Inventions in Incandescent Gas Lighting which Letters Patent are now the property of the Plaintiff Company and His Lordship granted a certificate that the validity of the Plaintiff's Patents was established.
FAITHFUL AND OWEN,
11, Victoria Street,
Westminster,
(Plaintiffs' Solicitors).
Nov. 2, 1894.

IMPERIAL CONTINENTAL GAS ASSOCIATION
INCORPORATED BY ACT OF PARLIAMENT.

NOTICE is Hereby Given, that the HALF-YEARLY ORDINARY GENERAL MEETING of the Proprietors of this Association was held at the City Terminus Hotel, Cannon Street, London, on Tuesday, the 6th inst.,
Sir JULIAN GOLDSMID, Bart., M.P., in the Chair, when the following Resolutions were unanimously passed:—
"That the Report of the Directors upon the affairs of the Association be received, adopted, and entered upon the Minutes."
"That a Dividend of 5 per cent. for the Half Year ended the 30th of June last, and a Bonus of 1 per cent. be declared upon the £3,800,000 Capital Stock of the Association, and that the same be payable, free of Income-Tax, on and after the 1st of December next."
"That the Auditors' remuneration be raised to a Yearly fee of One Hundred Guineas each."
"That the cordial thanks of the Meeting be given to the Directors for their able management of the affairs of the Association, to the Chairman for his conduct in the Chair this day, to the Secretary and the London Staff, and to Mr. H. V. Lindon, the Agents, Engineers, and other Officers of the Association on the Continent."
By order of the Board,
R. S. GARDINER,
Secretary.
No. 21, Austin Friars, London, E.C.,
Nov. 7, 1894.

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Practical Photometry.

By William Joseph Dibdin, F.I.C., F.C.S.

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Chelsea, East London, Grand Junction, Kent, Lambeth, New River, Southwark and Vauxhall, and West Middlesex—showing the Capital, Income, Expenditure, Profits, and Dividends per Million and per Thousand Gallons of Water supplied; the proportion of Expenditure and Profits to Gross Income; and the Income, Expenditure, and Profits per House, &c., supplied for the Year ended December 31, 1893, or March 31, 1894, together with the quantity of Water supplied, the estimated daily quantity supplied for domestic and other purposes, the quantity supplied per head of population, &c., &c., for the Year ended December 31, 1893.

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Containing references to all the Literature (English and Foreign) on Reducing or Abolishing the Guide-Framing of Gasholders, also the principal Literature on Gasholder Construction generally, compiled to March, 1893; with a List of all the English and Foreign Periodicals connected with the Gas Industry.
COMPILED BY
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Associate Member of the Institution of Civil Engineers; Fellow of the Imperial Institute; Member of the Institution of Gas Engineers; Member of the Society of Arts
AUTHOR OF
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Coke . . . . . 68 per cent.

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Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

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Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

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Yield of Gas per ton . . . . . 10,500 cub. ft.
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WORKED BY THE
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OUT OF THEIR
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The Analysis made by Messrs. J. and H. T. Pattinson, Public Analysts for Northumberland, gives 10,300 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a Working Analysis made of these Coals by the Tudhoe and Sunderland Bridge Gas Company:—

[COPY.]
TUDHOE AND SUNDERLAND BRIDGE GAS COMPANY.
Tudhoe Gas-Works,
Spennymoor,
8th June, 1893.

Messrs. The
WEARDALE IRON & COAL COMPANY, LTD.
GENTLEMEN,

For the last two months we have used your **THORNLEY GAS COAL** exclusively at these gas-works; and I have pleasure in herewith giving you the actual results obtained during the trial.

Yield of Gas per ton: 10,300 cubic feet.
Yield of Coke: 13½ cwt.
Illuminating Power of Gas, average of a series of tests, **17 Sperm Candles.**
The Coke was of excellent quality.
The following is a complete ultimate Analysis of the Coal.

	PER CENT.
Carbon	83·128
Hydrogen	5·116
Oxygen	7·401
Nitrogen	0·585
Sulphur	0·620
Ash	3·130
Water	0·020
	100·000

Analysis of the Coke.

Carbon	93·31
Sulphur	0·61
Ash	5·00
Moisture	1·08
	100·00

I am, Gentlemen,
Yours truly,
A. B. COWAN,
Manager.

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time, labour, and expense.

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Prices are Reduced.

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SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY.

Strongly recommended where EXCESSIVE HEATS have to be maintained.

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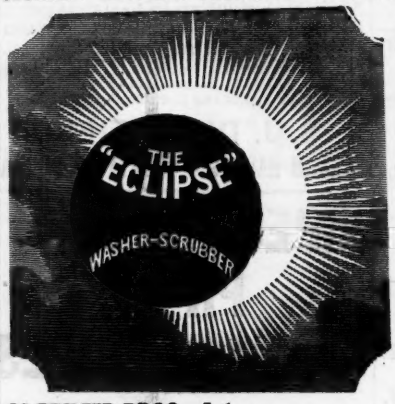
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

SEE ADVT., p. 900 OF LAST WEEK'S JOURNAL ALSO END PAGE OF NEXT ISSUE.



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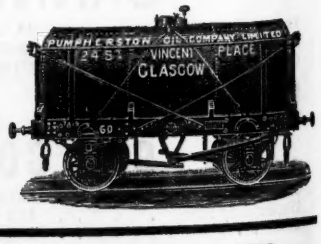

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CONDENSERS.

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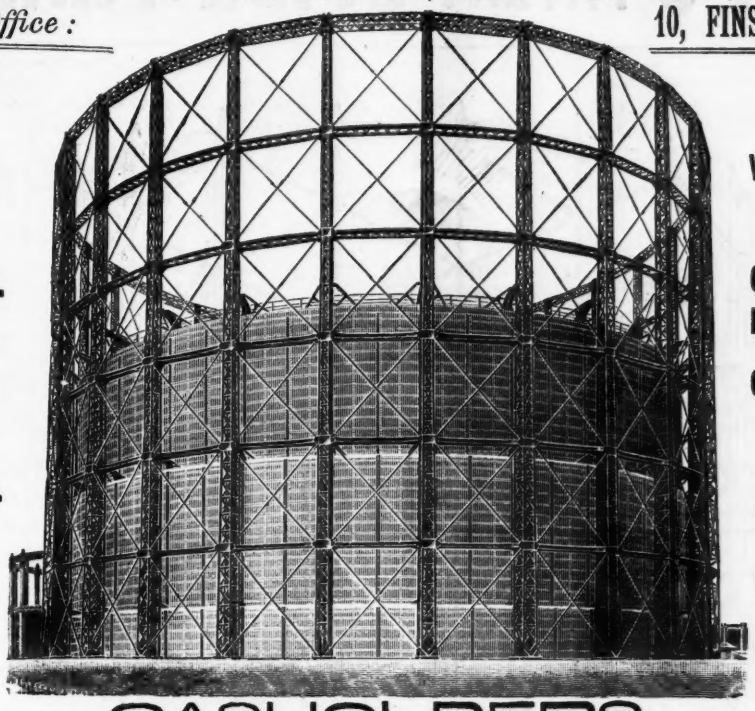
SULPHATE OF AMMONIA PLANT.



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CENTRE & FOUR-WAY VALVES.

CRIPPS' HYDRAULIC MAIN VALVE.

RETORT-MOUTHPIECES.

SLIDE-VALVES, TAR-BURNERS, SIEVES.

The above is a view of the largest Gasholder (four-lift) of The Gaslight and Coke Company, Beckton, containing 8 million cubic feet, erected by us in 1892.

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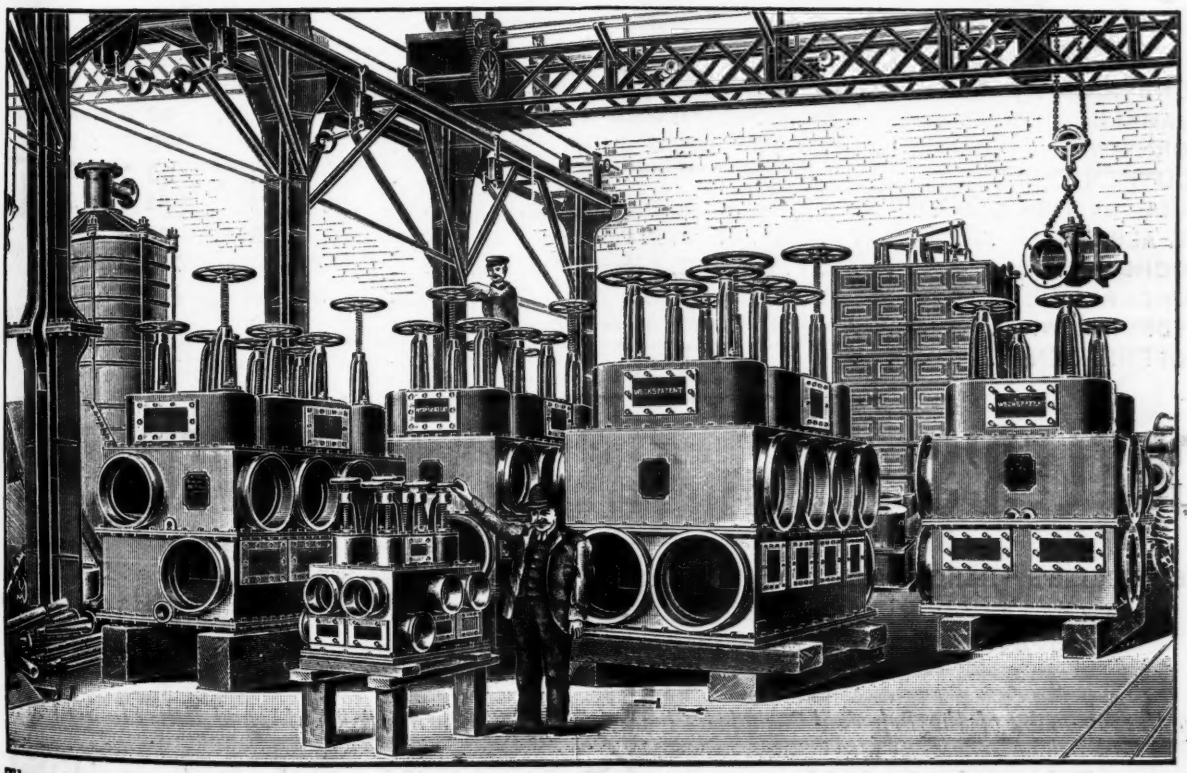

The above is a copy of a Photo. of two out of Four 24-inch Eight-Way Valves for Belfast, one 24-inch Four-Way for Manchester, one 20-inch Eight-Way for Harrogate, one 6-inch Six-Way for Sheffield. These Valves were Photographed before being dispatched from our Works.

Sole Makers: C. & W. WALKER.

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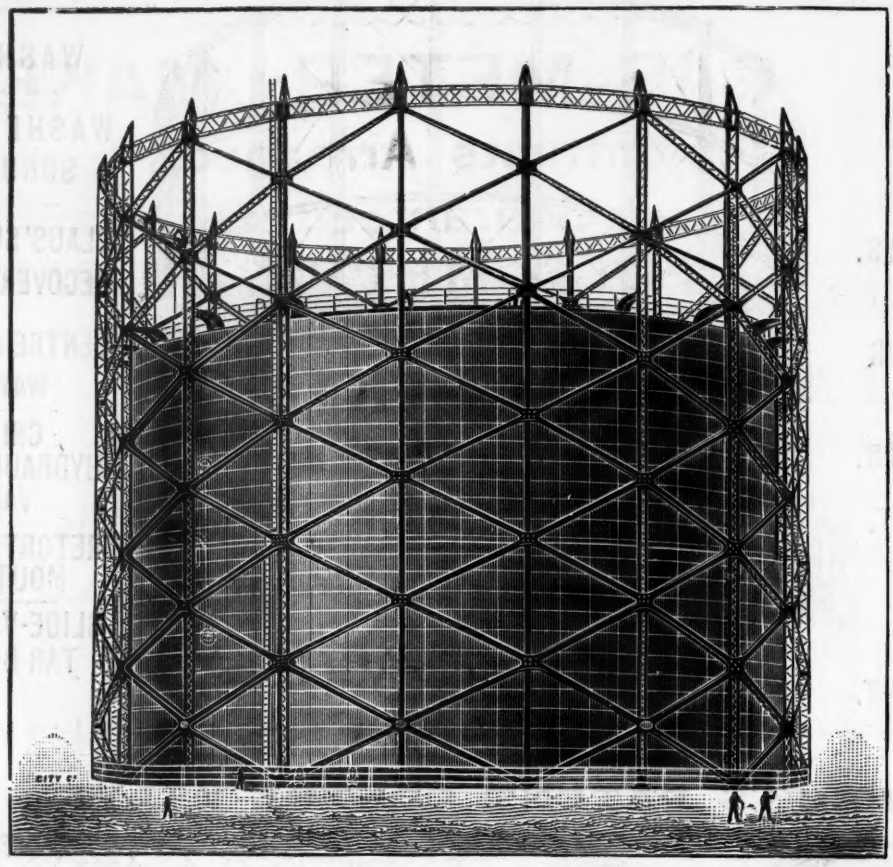
SAFE.

CHEAP.



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SHANKLIN	G. Garnett, Esq.	2 „	60	0	×	20	0
HORNSEY	H. J. Mitchell, Esq.	3 „	110	6	×	35	0
SOUTHEND	F. Clark, Esq.	2 „	90	0	×	25	0
HULL (BRITISH GAS CO.)	A. Dougall, Esq.	3 „	81	6	×	30	0
ST. ALBANS	A. F. Phillips, Esq.	2 „	68	0	×	22	0
ROCHDALE	T. Banbury Ball, Esq.	4 „	150	0	×	34	0
SUNDERLAND	Messrs. T. & C. Hawksley	3 „	150	0	×	32	0
RYDE, I. of W.	G. Garnett, Esq.	2 „	82	0	×	25	0
COPENHAGEN	For Municipality	3 „	175	0	×	30	0

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Every Telescopic Gasholder should be fitted with this appliance, to avoid the considerable risks arising from the action of Frost.

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Guaranteed 5 Years.

OLD METERS REPAIRED.

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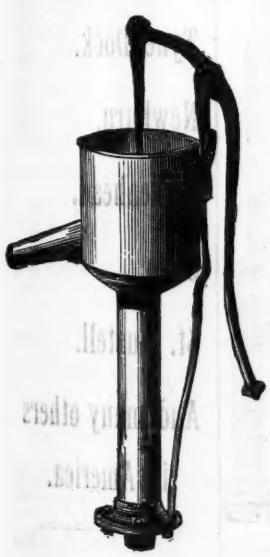

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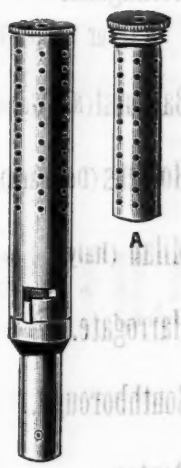
CONSTRUCTED SO THAT THE INTERIOR "A" CAN BE REMOVED FOR CLEANING.



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L. L. MERRIFIELD, Chief Engineer,
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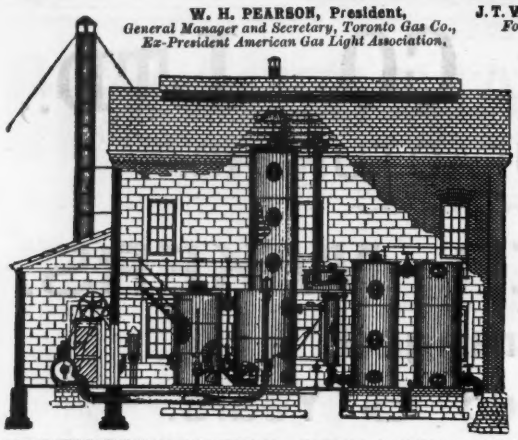

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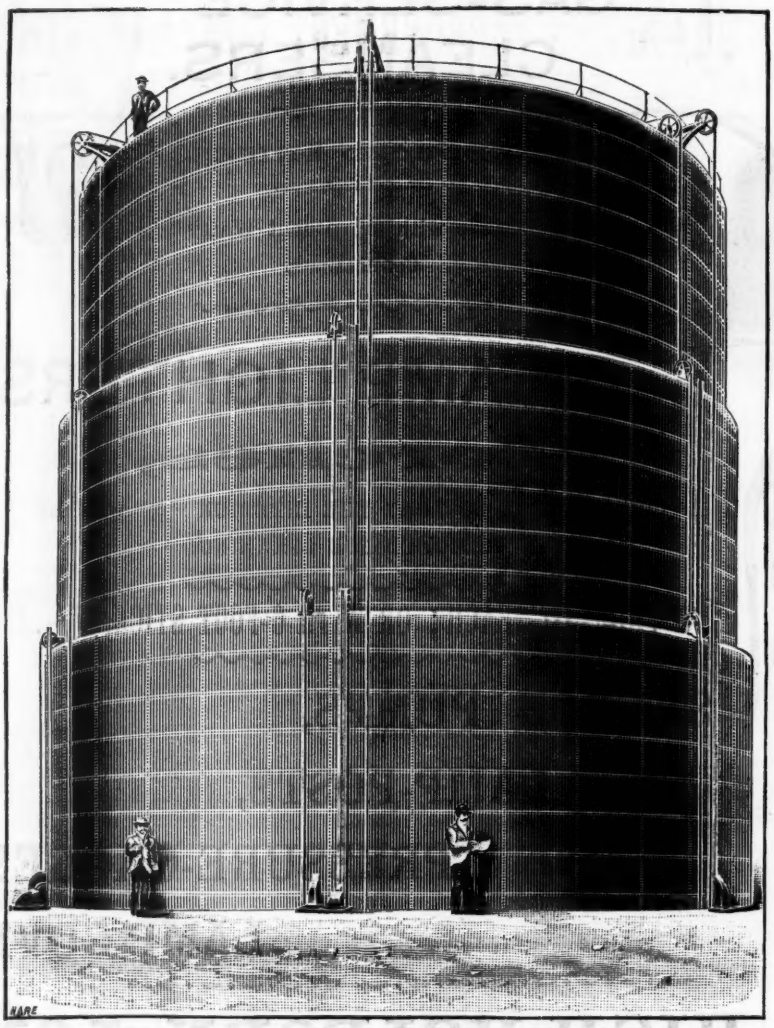

From a Photograph of Three-Lift Holder at Sligo (1894).

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SAMPLE CARGO will demonstrate the extraordinary value of this Coal, and of the resultant Coke and other Bye-Products.

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COKE.—Briefly the "Bear Creek" Cannel produces a first-class Coke—that is, by itself, and unmixed with Coke from Common Coals—merchantable, comparing favourably with Coke from the Standard Gas Coals.

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THE CARBURETTOR is INEXPENSIVE, EASILY FIXED, and ENTIRELY SUPERSEDES the use of CANNEL COAL.

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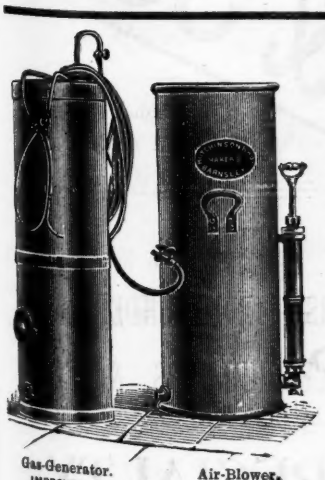

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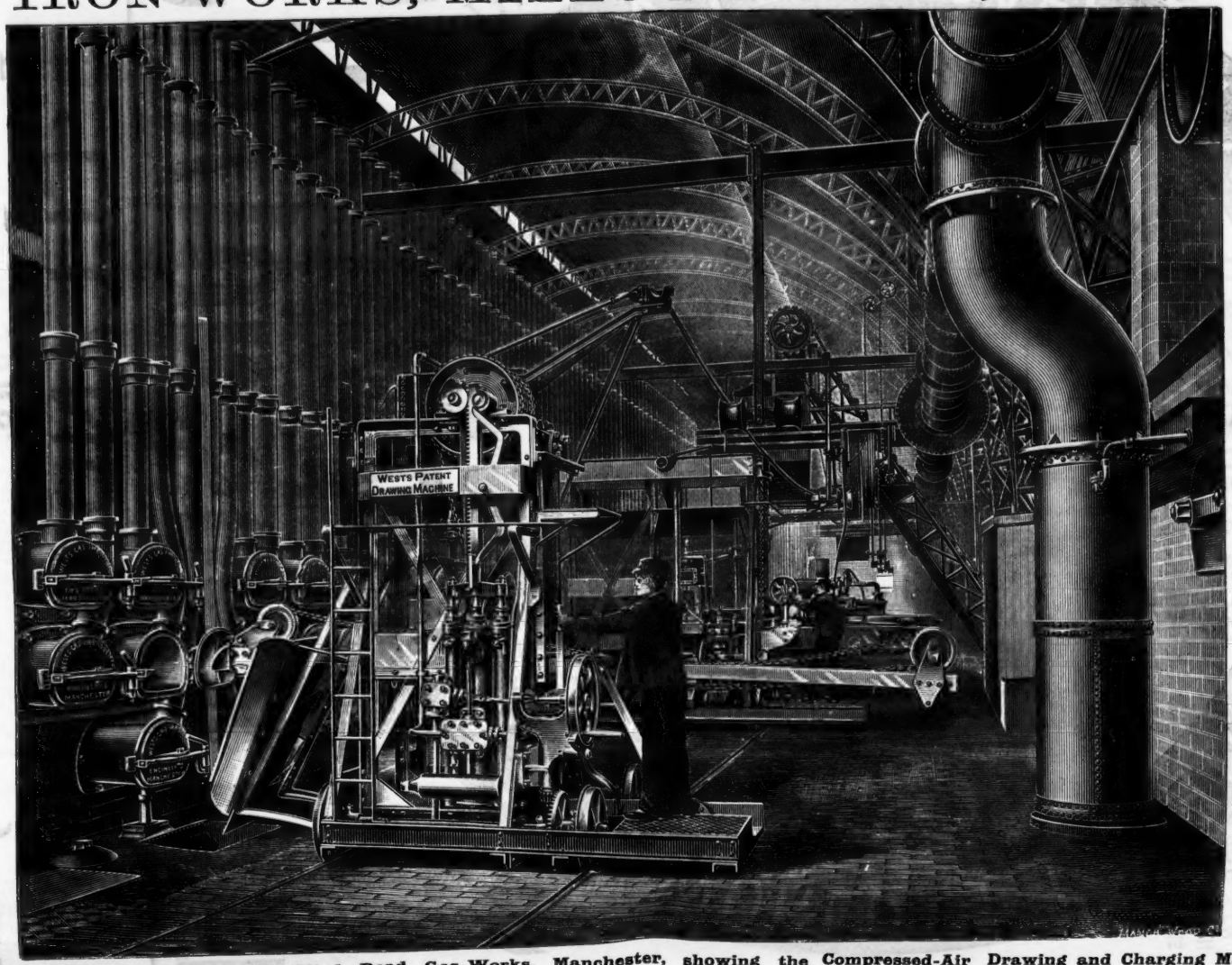

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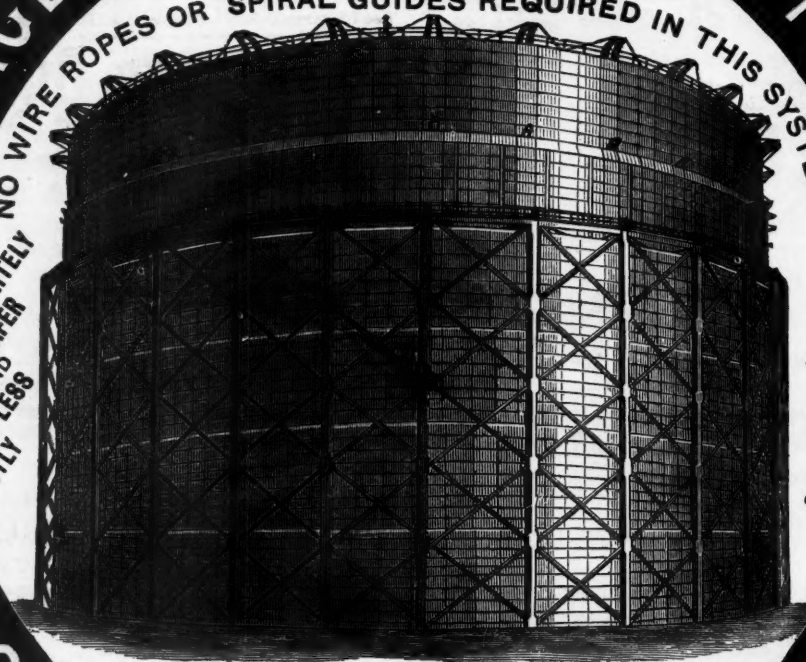
INFINITELY SAFER AND FAR LESS COSTLY THAN ROPES OR SPIRAL GUIDES.



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IT HAS SIX LIFTS 30 FT. DEEP EACH AND IS 300 FT. DIAR.

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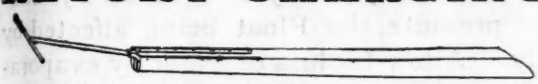
STEEL SCOOPS
FOR
RETORT CHARGING.



Scoops supplied with or without handles, and of any dimensions or shape required.

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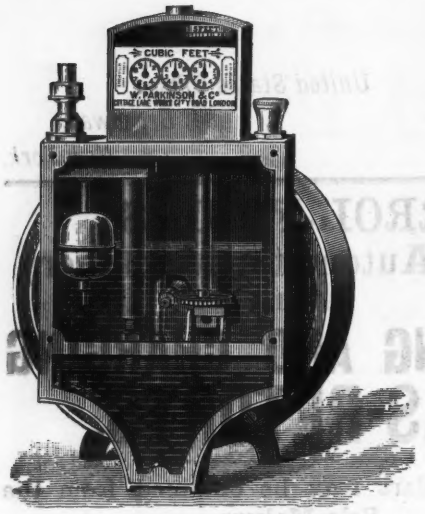

ORDINARY WET METERS

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Work with very little friction. Will stand very high pressures. Cannot possibly be shut off by sudden increase of pressure, the Float being affected by Outlet Gas only. Allow for loss of water by evaporation without materially affecting the registration or shutting off the gas. Unexcelled for simplicity of construction, excellence of workmanship, or accuracy in registration.

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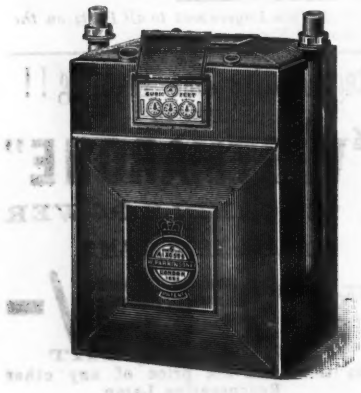

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[See also Advt., p. 910.

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